A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

JUNE, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

2267. Atomic Nuclei. W. Heisenberg. *Ned. T. Natuurk.* 6. 5–6. *pp.* 89–98, 1939.—This is an account of a lecture given at the Philips lamp works. It describes modern theories of nuclear structure in terms of protons, neutrons and spin. Questions of chemical valency forces are discussed from the point of view of quantum mechanics. Various nuclear models constructed from single particles, pairs, and α-particles are described and discussed. The nuclei of Be^8, C^{12}, O^{16}, Ne^{20} and Fe are described in terms of the α-particle crystal models of W. Wefelmeier [see Abstract 1 (1938)]. G. G.

✱2268. Advances in Nuclear Physics Due to Improved Apparatus and Methods. J. Mattauch. *Naturwiss.* 27. *pp.* 185–195, *March* 24, *and pp.* 201–205, *March* 31, 1939.—A review dealing with improvements in apparatus and the discoveries in nuclear physics consequent upon them. The apparatus described includes electron counters, mass-spectrographs, h.v. generators and the cyclotron. The use of the cloud-chamber in elucidating problems of nuclear physics is also described. A. J. M.

2269. Analysis of Nuclear Binding Energies. W. H. Barkas. *Phys. Rev.* 55. *pp.* 691–698, *April* 15, 1939.—The fine structure of the mass defect curve has been studied, especially with reference to the nuclear symmetry character. From the analysis it has been found possible to obtain satisfactory empirical curves for the functions L and E_0 appearing in Wigner's theory [see Abstract 2873 (1937)]. The behaviour of these curves allows deductions to be made regarding nuclear shells, and binding energies of both known and as yet unknown, unstable, nuclei. About 150 masses have been computed in this way. AUTHOR.

2270. Packing Fraction Differences Among Heavy Elements. A. C. Graves. *Phys. Rev.* 55. *pp.* 863–867, *May* 1, 1939.—A group of new packing-fraction-difference measurements are reported for the following elements: Cr, Gd, Au, Lu, Mo, Os, Pt, Ru, Sr, Ta, Sn, U, Yb and Zr. By combining these differences with known packing fractions a number of new packing fractions are deduced. These are plotted on a packing-fraction curve. Atomic weights of Os and Lu are calculated. The atomic weight of Os is still below the chemical value, while that of Lu is shown to be the same as a recent chemical determination. AUTHOR.

2271. Nuclear Packing Effect. A. H. W. Aten, Jr. *Physica*, 6. *pp.* 425–434, *May*, 1939. *In German.*—Using a statistical nuclear model built up of neutrons and protons in the closest possible packing, the author has made a calculation of the surface energy of nuclei, and obtained a reasonably good agreement with the accepted values. Further it is shown that the attractive forces existing between protons in the free state or in the bound state in H atoms, are little, if any, larger than the binding energies of compound nuclei. The values for the nuclear radii used in the calculations were deduced from the cross-sections for collisions between atoms and fast neutrons. G. O. B.

2272. Concentration of Isotope C^{13} by a Diffusion Method. M. de Hemptinne and P. Capron. *J. de Physique et le Radium,* 10. *pp.* 171–175, *April,* 1939.—A battery of 51 Hg diffusion pumps was used, of Hertz's model as modified by Bleakney and Sherr. The effect of gas pressure, wattage of electrical heaters, and radius of capillaries between the pumps, was studied quantitatively (using CO_2–A, and CO_2–N_2 mixtures) to determine optimum conditions. For separation of C^{13}, a supply of CH_4 comprising 700 l. measured at 2 mm. pressure, was adsorbed on silica gel at liquid-air temperature, and then released into the system. After 30 hr., 300 cm^3. (at 1·8 mm.) of CH_4 containing 30–32% of C^{13} was obtained and a second separation gave 50% of C^{13}. S. J. G.

2273. Mutual Influence of Valencies in the Carbon Atom. T. Förster. *Zeits. f. phys. Chem.* 43. *Abt.B.* 1. *pp.* 58–78, 1939.—It is shown that the strength of a bond in a C atom is dependent on the neighbouring bonds, and an explanation of this phenomenon is now given which is based on the quantum-mechanical theory of homopolar valency applied to the electronic structure of the tetravalent C atom. This is provided by the Heitler-London theory together with the Slater assumption of localised bonds, which lead to a satisfactory agreement with experimental data. Application of the above procedure to ring strain phenomena affords precise statements such as that of the classical Baeyer strain theory. H. H. Ho.

2274. Electron-Diffraction Study of Acetylenic Compounds. L. Pauling, H. D. Springall and K. J. Palmer. *Am. Chem. Soc., J.* 61. *pp.* 927–939, *April,* 1939.—The electron-diffraction study of gas molecules of methylacetylene, dimethylacetylene, dimethyl-diacetylene, methyl cyanide, diacetylene, and cyanogen has been carried out. The interatomic distances are given. It is suggested that the decrease below the normal value 1·54 Å for a single bond adjacent to a triple bond found for the methylacetylenes (1·46–1·47 Å) and methyl cyanide (1·49 Å) is due partly to a change in single-bond radii (by about 0·02 Å) and mainly to the assumption of partial double-bond character by the single bond. The values found for a single bond between two conjugated triple bonds (1·36–1·38 Å in diacetylene, dimethyldiacetylene, and cyanogen) are interpreted as indicating about 40% double-bond character for this bond, the amount of conjugation being about twice that for systems involving double bonds and benzene rings. AUTHORS.

2275. Structure of Tetranitromethane. A. J. Stosick. *Am. Chem. Soc., J.* 61. *pp.* 1127–1130, *May,* 1939.—A structure for tetranitromethane is proposed which is in agreement with electron diffraction data. In the model there are four nitro groups attached to the C atom at tetrahedral angles; the C–N distance is 1·47 ± 0·02 Å, the N–O distance is 1·22 ± 0·02 Å, and the angle O–N–O in the nitro group is 127°. In order to obtain satisfactory intensity agreement it was necessary to assume the nitro groups to be undergoing rotatory oscillation about the C–N bonds in such a way as to keep the O–O repulsions essentially minimised, and to include the usually omitted temperature factor in the approximate intensity formula. AUTHOR.

2276. Ionic Character in Diatomic Molecules. F. T. Wall. *Am. Chem. Soc., J.* 61. *pp.* 1051–1053, *May,* 1939.—Assuming the wave function of a molecule to be given by $\psi = \psi_c + a\psi_1$ where ψ_c and ψ_1 are covalent and ionic functions, respectively, the constant a is shown to be determined by $a^2 = (W_c - W)/(W_1 - W)$. Values for a^2 are determined

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empirically and correlated with ionic character and dipole moment values. AUTHOR.

See also Abstracts 2349, 2374, 2481, 2527, 2625, 2627.

COLLOIDS.

2277. Particle Sizes in Stratified Alumina Hydrosols M. A. Miller. *J. Phys. Chem.* 43. *pp.* 631–636, *May*, 1939.—Calculations of particle sizes in an apparently stable, stratified, alumina hydrosol system, based on the rate of stratification, have given results which are of the correct order of magnitude. This suggests that whenever a rate of stratification is exhibited, Stokes' law, alone or in combination with Einstein's equation for Brownian movement, may be applied to the velocity of settling of zones. It has been briefly indicated how Perrin's and Odén's equations may be applied to stratifying systems in order to obtain information relative to the amount of material present and the percentage class size and size distribution of particles. AUTHOR.

2278. Silica Gels from Various Acids. Effect of Concentration and Mixtures on Setting Time. H. L. Davis and K. D. Hay. *Am. Chem. Soc., J.* 61. *pp.* 1020–1023, *May*, 1939.—Silica gels produced by mixing sodium silicate with varying concentrations of HCl, H_2SO_4, H_3PO_4 and CH_3COOH set in a minimum time when the final system is at pH 8 or somewhat more alkaline than this. Departure from this zone of rapid setting produces a sharp rise in the time of set, except where a buffer action enters in the acid systems. All of these acids produce a series of rapidly setting gels in strongly acid systems. It has been shown that a very small excess of HCl causes the setting time to rise steeply to a sharp maximum, and it appears that for the other acids similar closed curves exist. For mixtures of H_2SO_4 with HCl or acetic acid in which the total normality is kept constant, the time of set is not a linear function of the composition of the mixture. On increasing the concentration of acid added to sodium silicate, four types of system are found: stable alkaline negative silica sols, rapidly setting gels, stable acid positive silica sols, and finally a second series of gels in concentrated acid systems AUTHORS.

2279. Elastic Extensibility of Muscle. G. W. F. Brisbin and F. Allen. *Canad. J. of Research*, 17. *Sect. A. pp.* 33–48, *March*, 1939.—Measurements of the extensibility of muscles and other tissues were first made, as far as the authors are aware, by Wertheim in 1846. He proposed for them a hyperbolic law of elasticity of the form: $y^2 = ax^2 + bx$. Further measurements were made at much later dates by Marey and by Howell, who did not attach to them any mathematical law of elasticity. The present writers have investigated the elasticity of muscles again, and have found that their own data, as well as those of previous investigators, conform to the logarithmic law, $E = k \log W + c$, where E is the extension, W the stretching force, and k and c are constants. This law is found to hold for muscles both striped and plain, and for nerve tissue. It seems to be true for all tissues except bone which, according to Wertheim, follows Hooke's law of elasticity for inorganic elastic matter. AUTHORS.

2280. Molecular Constellation and Crystallite Orientation as Causes of Caoutchouc-Like Elasticity. W. Kuhn. *Kolloid Zeits.* 87. *pp.* 3–12, *April*, 1939.—The result found in earlier quantitative investigations, where the magnitude of the elasticity modulus in the case of the ideal caoutchouc elasticity does not depend (or only slightly) on the degree of completeness of the free rotatability of the C–C bands in the substance, is now more approximately illustrated by evidence for the essential features of this viewpoint. It is further shown, that by extension of a substance which contains rigid long crystallites or micelles in addition to flexible fibre molecules, elastic effects occur which are comparable with the constellation effects of the fibre molecules. This is due (according to qualitative experiments made by Wöhlisch) to the orientation of the crystallites caused by the extension together with corresponding thermal disturbances. It is shown that in a substance which contains p_k gm./cm^3. of crystallites of average molecular weight M_k, the re-orientation of the crystallites produces a modulus of elasticity $E_k = \frac{3}{5}\ RTp_k/M_k$. In addition there are further partial elasticity moduli which proceed from the constellation isomerism of the fibre molecules. The measured modulus of elasticity of a substance is therefore in general a very composite quantity.

H. H. Ho.

2281. Electrokinetic Investigations of Natural Silk. Part I. T. Takada and K. Kanamaru. *Kolloid Zeits.* 87. *pp.* 68–73, *April,* 1939.—An attempt to explain the mechanism of the separation of raw silk and its structure in the light of the lyophilic properties of lyophilic colloids. Experimental details are followed by numerous tables. The paper covers the investigation of the alteration of the ζ-potential of water bleached and boiled *Bombyx-mori* silk as also the simultaneous alteration of the sorption isotherm of silk for water vapour in accordance with the duration of the cooking period. It was found that the ζ-potential /time curve of an incompletely cleaned silk sample has a minimum and that this curve is definitely affected in position by the degree of cleanliness attained. The ζ-potential/time curve of fully cleaned silk has no such minimum in the normal curve and corresponds in general to that obtained for a lyophilic colloid. The relationship of the ζ-potential to the hygroscopic and dyeing properties of the fibre is explained as stated above. S. G. B.

2282. Water-in-Oil Emulsions. Part II. R. C. Pink. *Chem. Soc., J. pp.* 619–621, *April,* 1939.—The effect of magnesium and calcium oleates on the interfacial tension between benzene and water has been measured by the drop-weight method. The marked lowering observed is an important factor in the stabilisation of water-in-oil emulsions. The effect of these soaps on the surface tensions of benzene and water has also been examined. [For Part I see Abstract 4287 (1938).] AUTHOR.

2283. Surface Boundary Charge of Viscose in Relation to its Maturity. K. Kanamaru, T. Kobayasi and M. Seki. *Kolloid Zeits.* 87. *pp.* 62–68, *April,* 1939.—The surface boundary charge value of viscose in relation to water according to its maturity is investigated. Approximately at the moment when the minimum viscosity of the viscose is attained the surface boundary charge curve is inflected from negative to positive in direction corresponding to the aggregation of the viscose as shown by the viscosity curve. A plausible explanation of the phenomena is given on the basis of previous work. The results agree excellently with the theory of Mark regarding the initial diminution of the viscosity of viscose rather than with the gel theory. S. G. B.

2284. Groupings of Atoms of Radiocolloids. C. Chamié. *Comptes Rendus,* 208. *pp.* 1300–1301, *April* 24, 1939.—A solution of Po (10^{-5} gm. in 2 cm^3. strong HCl) was centrifuged for 1 hr. at 3200 r.p.m., then poured on to glass coated with paraffin, and the paraffin layer pressed against a photographic plate. On development this showed numerous black spots indicating that the paraffin had retained about 0·1% of the Po as groups of atoms. A solution of active deposit of Th gave no such indications when similarly treated. From the centrifugation curves of radiocolloids, it is suggested that formation of colloidal groups obeys a probability law, and therefore that there is a certain probability that a radiocolloid solution in strong acid will form groups, while in the case of a crystalloid the probability is nil. [See Abstract 2508 (1929).] C. A. S.

2285. Influence of Salts on the Melting Point of Gelatin Gels. J. H. C. Merckel and P. W. Haayman. *Kolloid Zeits.* 87. *pp.* 59–62, *April*, 1939.—The melting point of gelatin is determined as influenced by the introduction therein of various Na salts. From the results it is shown that the distance between the molecules in the gel can be determined, and the value so obtained is in agreement with that obtained from X-ray analysis. It is noted that except with NaH_2PO_2 there is a decrease in melting point with increased concentration of salt. S. G. B.

See also Abstracts 2303, 2304, 2310, 2311, 2312, 2340, 2362, 2512.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2286. Packing of Congruent Circles in Planes and in Layers. U. Sinogowitz. *Zeits. f. Krist.* 100. 6. *pp.* 461–508, 1939.—The author discusses the theory of the various methods of packing circles in planes and in layers. A classification is given differentiating between 131 groups and subgroups, each one being illustrated by a figure. The groups are also tabulated showing the relation between the present classification and the earlier work of Laves [1931]. J. I.

2287. Influence of Camera Size and Slit Shape on Measurements of the Lattice Constant by the Asymmetrical Method. A. Ieviņš and K. Karlsons. *Zeits. f. Physik*, 112. 5–6. *pp.* 350–361, 1939.—Using the asymmetrical powder method [see Abstract 991 (1936)] values consistent to within less than ± 0·001% were obtained for the lattice constant of Al under different conditions as long as the diameter of the Debye-camera employed was between 29 and 64 mm. and the diameter of the stop limiting the primary beam did not exceed 1 mm. Larger cameras gave rise to more than proportionally broadened lines. Replacing the stop by a slit (0·5 by 3 mm.) had a similar effect and gave consistently lower values for the lattice constant. L. E. F.

2288. Structure of Al_2Ca. H. Nowotny and A. Mohrnheim. *Zeits. f. Krist.* 100. 6. *pp.* 540–542, 1939.—Al_2Ca is examined by powder photographs. It is of the C-15 type—Cu_2Mg—and has a very narrow range of homogeneity. The length of the side of the unit cell is $8{\cdot}02_2$ Å, and the calculated interatomic distances suggest weak polarisation. J. T.

2289. ZnS-MnS Solid Solutions. F. A. Kröger. *Zeits. f. Krist.* 100. 6. *pp.* 543–545, 1939. *In English.*—Lattice constants for three modifications of MnS and two of ZnS are summarised, despite the similarity complete miscibility is not found. On heating ZnS-MnS mixtures with NaCl as flux in non-oxidising atmospheres between 800° and 1200° C., photoluminescent orange coloured solid solutions were obtained, the colour deepening to red at 52% MnS, the limit for 1180° C. The hexagonal axis was found to be a linear function of composition. Above 52% MnS the green modification crystallises out pure. At low MnS content the solid solution shows würtzite or sphärelite structure according to its formation temperature, at higher MnS content the former is found exclusively. D. R. H.

2290. Lattice Distortion in Pyrophoric Metals. G. R. Levi and G. Rossi. *Gazz. Chim. Ital.* 68. *pp.* 570–581, *Sept.*, 1938.—Brill's method of deducing lattice distortion from measurements on Debye-Scherrer photographs is examined critically from a mathematical standpoint [see Abstract 2924 (1937)]. For Fe containing C the distortion at 200°, 400°, and 500° C. is respectively 0·10, 0·07 and 0·036 Å, for filings 0·12 Å, in comparison with 0·106 and 0·086 Å found for Cu and Ni by Brindley and Spiers. It appears that the method is liable to error from non-uniform blackening in the thickness of the film, incorrect choice of absorption factor *A*, or error in the photometric curve. Mean quantitative values appear to rest on a sound theoretical basis but cannot be used to deduce more exact theoretical results, and care must be taken not to push the method beyond the degree of sensibility which it can attain. Results for pyrophoric Fe [see Abstract 2940 (1938)] are confirmed, for Pb the distortion is too little to be a measure of pyrophoricity, the pyrophoric particles are apparently above the size limit for which the Laue-Brill relation holds. Pyrophoric Ni from Raney alloy shows very fine sub-division and mean lattice distortion of 0·16 Å, that from reduction of NiO also shows distortion. Apparently Pb shows pyrophoricity without marked distortion or particle fineness, on account of its rapid oxidation. In Fe there seems to be little difference in particle size between active and non-active forms, and therefore lattice distortion can be used as a measure of pyrophoricity. In the less easily oxidised Ni, high lattice distortion is certainly a cause of pyrophoricity, in Raney Ni this is accentuated by fine particle size.
D. R. H.

2291. Lattice Distortion in Cu, Ni and Rh. G. W. Brindley and P. Ridley. *Phys. Soc., Proc.* 51. *pp.* 432–448, *May,* 1939.—The lattice distortion in filed powders of Cu, Ni and Rh is found to be accompanied by an increase in width and a decrease in intensity of the X-ray reflections. The experimental results are incapable of explanation by the periodic displacements assumed by Dehlinger and Boas, and it is concluded that the broadening of the reflections is due to distortion of a non-periodic type, namely a variation of lattice parameter from one crystalline grain to another; while the decrease of intensity is due to irregular, effectively random, atomic displacements. It is considered that the energy of a distorted metal resides mainly in these displacements and not in the macroscopic stresses which extend over entire grains. J. T.

2292. Equilibrium Diagram of Iron-Nickel Alloys. E. A. Owen and A. H. Sully. *Phil. Mag.* 27. *pp.* 614–636, *May,* 1939.—The paper contains an account of the determination by X-ray methods of the positions of the α and γ boundaries in the equilibrium diagram of the Fe-Ni system of alloys. The alloys were given careful heat treatments, and the effects of these treatments on the structures of the alloys were studied. Spectra were taken with material maintained *in vacuo* at high temperatures reaching up to about 800° C., a special design of high temperature camera being used for the purpose. An attempt is made with the aid of the proposed new equilibrium diagram to explain certain experimental facts which were difficult to account for on the basis of previous diagrams. AUTHORS.

2293. Structure of Phosphorus Sulphoxide. A. J. Stosick. *Am. Chem. Soc., J.* 61. *pp.* 1130–1132, *May,* 1939.—The structure of $P_4O_6S_4$ has been determined by electron diffraction in the gas phase. The molecule consists of four P atoms at (a, a, a), (a, $\bar{a}$, $\bar{a}$), ($\bar{a}$, $\bar{a}$, a), and

($\bar{a}$, a, $\bar{a}$) ; six O atoms at ($\pm$ b, 0, 0), (0, $\pm$ b, 0), and (0, 0 $\pm$ b) ; and four S atoms at (c, c, c), (c, $\bar{c}$, $\bar{c}$), ($\bar{c}$, $\bar{c}$, c) and ($\bar{c}$, c, $\bar{c}$). The valence angles and the principal interatomic distances are : P–O = 1·61 ± 0·02 Å, P–S = 1·85 ± 0·02 Å, P–P = 2·85 ± 0·03 Å, O–P–O = 101·5 ± 1°, P–O–P = 123·5 ± 1°, and O–P–O = 116·5 ± 1°. Single-double bond and double-triple bond resonance is considered to be the cause of the shortening of the P–O and P–S bond distances below the single and double bond values, respectively. AUTHOR.

2294. Structures of Complex Fluorides. J. L. Hoard. *Am. Chem. Soc., J.* 61. *pp.* 1252–1259, *May,* 1939.—It is shown from X-ray data that the isomorphous crystals K_2CbF_7 and K_2TaF_7 possess nearly identical monoclinic (pseudo-orthorhombic) units of structure with $a_0 = 5{\cdot}58$ Å, $b_0 = 12{\cdot}67$ Å, $c_0 = 8{\cdot}50$ Å, $\beta = 90°$, space group $C_{2h}^5 - P2_{2_1/c}$, containing four molecules. A Patterson projection on (100) utilising visually estimated intensities from excellent photographs is interpreted unambiguously to give approximate values of *y* and *z* parameters for Cb or Ta and K atoms (all atoms are in general positions). These data suffice to determine the phase of all important (0*kl*) amplitudes ; a Fourier projection on (100) of relative electron density for each compound yields *y* and *z* coordinates for all atoms. A Fourier analysis of the less satisfactory (*hk*0) data gives *x* coordinates of all atoms and checks rather closely the *y* parameter values of the (100) projection. Parameter data account satisfactorily for the intensities of X-ray reflections, and lead to generally reasonable interatomic distances. The structure is an aggregate of K^+ and $CbF_7^=$ or $TaF_7^=$ ions. Although not required by the space group to possess any symmetry, the undistorted $CbF_7^=$ or $TaF_7^=$ ion would show apparently the symmetry of $C_2^v - mm$. This configuration is entirely different from that recently reported for the $ZrF_7^{\equiv}$ ion of symmetry $C_3^v - 3\,m$. It is probable that the extensive series of stable fluotantalates having the atomic ratio 7F/Ta contains $TaF_7^=$ ions with the configuration established in this paper. AUTHOR.

2295. Structure of Nacrite and Polymorphism of Kaolin Minerals. S. B. Hendricks. *Zeits. f. Krist.* 100. 6. *pp.* 509–518, 1939. *In English.*—The crystal structure of nacrite $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$ has been determined from X-ray diffraction data obtained from single crystals. Lattice constants are : Space group $C_s^4 - Cc$; 6 $[(OH)_8Al_4Si_4O_{10}]$ in unit of structure ; $a = 8{\cdot}94$ Å ± ·02 Å, $b = 5{\cdot}14$ Å ± ·02 Å, $c = 43{\cdot}0$ Å ± ·2 Å, $\beta = 90°\,20' \pm 10'$. The structure closely approaches rhombohedral symmetry and the pseudospace group is R3*c*, with 2 $[(OH)_4Al_2Si_2O_5]$ in the pseudo-unit of structure. Polymorphism of the kaolin minerals is discussed as determined by hydroxyl binding between layers of the structure. AUTHOR.

2296. Structure of $N(CH_3)_4ICl_2$. R. C. L. Mooney. *Zeits. f. Krist.* 100. 6. *pp.* 519–529, 1939. *In English.*—$N(CH_3)_4ICl_2$, prepared by passing Cl through a dilute solution of $N(CH_3)_4I$ and evaporating over H_2SO_4, forms tetragonal pyramids which have $a = 9{\cdot}18$ Å, $c = 5{\cdot}80$, with 2 mols in the unit cell ; space group $D_{2d}^3(P - 42_1\,m)$. The structure is that of CsCl somewhat distorted owing to the ions being complex. The ICl_2-ion is linear with I in the centre and I – Cl = 2·34 Å. Each Cl is coordinated to 8 CH_3 groups at an average distance of 3·75 Å. CH_3 – I = 4·56 to 4·73 ; N – I = 5·13 and 5·78. [See Abstract 933 (1938).] C. A. S.

2297. Patterson Analysis of Skeleton of Cyclol C_2 Molecule. D. P. Riley and I. Fankuchen. *Nature,* 143. *pp.* 648–649, *April* 15, 1939.—Vector maps have been constructed of the C and N atoms of the skeleton of the cyclol C_2 molecule. A comparison of these maps with the maps derived experimentally by Crowfoot [see Abstract 938 (1938)] from an X-ray investigation of insulin, shows that the X-ray data give no direct evidence in support of the cyclol structure proposed for insulin. J. I.

2298. Structure of Proteins. J. D. Bernal. *Roy. Inst., Proc.* 30. 3. *pp.* 541–557, 1939. *Nature,* 143. *pp.* 663–667, *April* 22, 1939.—The author discusses the different kinds of proteins and summarises the results that have been obtained by the three main physical methods of investigation viz. centrifugal, electrical and X-ray. The X-ray results are given in some detail and their significance in relation to the other data is discussed. J. I.

2299. Structure of Glycine. G. Albrecht and R. B. Corey. *Am. Chem. Soc., J.* 61. *pp.* 1087–1103, *May,* 1939.—X-ray data show that crystals of glycine are built upon a simple monoclinic unit cell having $a_0 = 5\cdot10$, $b_0 = 11\cdot96$, $c_0 = 5\cdot45$ Å, and $\beta = 111°38'$, containing four molecules. All atoms are in general positions of the space group $C_{2h}^5 - P2_1/n$. Analysis of photographic intensity data by means of Patterson-Harker projections served to establish the following atomic parameters: O (I), $x = 0\cdot805$, $y = 0\cdot410$, $z = 0\cdot740$; O (II), $x = 0\cdot360$, $y = 0\cdot360$, $z = 0\cdot610$; C $x = 0\cdot575$, $y = 0\cdot380$, $z = 0\cdot560$; methylene C, $x = 0\cdot565$, $y = 0\cdot365$, $z = 0\cdot280$; N, $x = 0\cdot800$, $y = 0\cdot410$, $z = 0\cdot245$. The structure consists of nearly flat glycine molecules held together by hydrogen bonds between adjacent N and O atoms to form continuous layers throughout the crystal. Inter-atomic distances within the molecule are: C-O, 1·25 Å, and 1·27 Å, C-C, 1·52 Å, C-N, 1·39 Å, each ± 0·02 Å (probable error). Hydrogen bond distances between N and O atoms in the same layer are 2·76 and 2·88 Å; between neighbouring layers, 2·93 and 3·05 Å. From a discussion of the probable positions of H atoms it is concluded that the atomic arrangement suggests a zwitter-ion structure for the glycine molecule in the crystal. AUTHORS.

2300. Isomorphous Replacement in Hydrated Salts. H. Bassett, J. H. Henshall, G. A. Sergeant and R. H. Shipley. *Chem. Soc., J. pp.* 646–660, *April,* 1939.

2301. Transformation of Anhydrous Sodium Palmitate from Crystal to Liquid. R. D. Vold and M. J. Vold. *Am. Chem. Soc., J.* 61. *pp.* 808–815, *April,* 1939.—Dilatometric and microscopic evidence shows that anhydrous sodium palmitate has at least five successive phase changes between 70 and 300°. The corresponding phases are curd fibres (up to 117°), subwaxy soap (117–135°), waxy soap (135–208°), subneat soap (208–253°), neat soap (253–292°) and isotropic liquid (above 292°). One or more of these phases may be formed during the process of soap manufacture, and may persist in some mixtures for long periods of time at room-temperature. These transitions may all be regarded as successive stages of melting, the phases intermediate between crystal and liquid being of mesomorphic nature. AUTHORS.

***2302. Octahedral Arsenious Oxide. M. Randall and T. C. Doody.** *J. Phys. Chem.* 43. *pp.* 613–622, *May,* 1939.—As_2O_3 recrystallised from HCl could not be washed free from chloride. Recrystallisation from boiling water produced traces of the arsenic oxide. A vacuum molecular still (described) gave very efficient purification of As_2O_3 by sublimation.

Conditions in the operation of the molecular still were found which gave a sublimate of true well-formed octahedral crystals. As_2O_3 crystals of needle-like appearance which do not show the birefringence of the monoclinic form were prepared. They were composed of chains and distorted octahedra indicating partial fusion. This form is believed to be closely related to an " octahedral liquid " derivable from the octahedral form with a small heat of transition. AUTHOR.

2303. Effects of Tissue Extracts on Crystallisation Pattern of Cupric Chloride. D. L. Morris and C. T. Morris. *J. Phys. Chem.* 43. *pp.* 623–629, *May*, 1939.—Certain colloidal solutions have been found to exercise specific effects on the crystallisation patterns produced by evaporation of aqueous solutions of cupric chloride under controlled conditions. In the case of oat extracts, the effect seems to be due to a polysaccharide. An active fraction which gives the characteristic pattern has been isolated from oats. AUTHORS.

2304. Cause of Colour of Blue Quartz, Charnockites, Champion Gneiss and other Related Rocks. N. Jayaraman. *Indian Acad. Sci., Proc.* 9*A*. *pp*. 265–285, *March*, 1939.—Specimens are examined microscopically and chemically. Acicular inclusions (fine rutile needles) are not responsible for the colour and the accompanying turbidity, which are considered to be due to colloidal particles of a Ti compound about 0·2 to 0·5 μ in dia. The Ti content of the coloured specimens is in excess of that due to the rutile inclusions. Both colour and turbidity are lost on heating. L. A. W.

See also Abstracts 2308, 2309, 2321, 2322, 2503, 2507, 2513, 2532, 2536, 2548, 2559.

DENSITY.

2305. Densities of Vapours Adsorbed on Charcoal. J. D. Danforth and T. De Vries. *Am. Chem. Soc., J.* 61. *pp.* 873–876, *April*, 1939.—The average densities of adsorbed CCl_4 and acetone on a steam-CO_2 activated cocoanut charcoal were determined at 30°. The average densities show a sharp decline after which a rise occurs. About 15 to 20% of the surface is covered with condensed vapour held by active centre forces. The remainder of the surface seems to be covered by a different process. AUTHORS.

2306. Density of Pure D_2O. H. L. Johnston. *Am. Chem. Soc., J.* 61. *pp.* 878–880, *April*, 1939.—Electrolysis of relatively large volumes of D-rich water has yielded residues with limiting density close to d^{27}_{27} 1·10769. Correction for a slight abnormality in O isotope ratios and for the difference in thermal expansions of H_2O and D_2O yields d^{25}_{25} 1·10763. D concentrations of recombined fractions taken in the electrolysis are in good agreement with values calculated from measured separation coefficients for H isotopes determined with the same cells, if the above figure is taken to be the specific gravity of pure D_2O, but are inconsistent with Taylor and Selwood's d^{25}_{25} 1·10790. The experimental observations indicate that Tronstad and Brun's published value d^{25}_{25} 1·10750 is definitely low but yield very close agreement with the revised value d^{25}_{25} 1·10764, attributed to them. AUTHOR.

2307. Density of Aqueous NaOH Solutions. G. Åkerlöf and G. Kegeles. *Am. Chem. Soc., J.* 61. *pp.* 1027–1032, *May*, 1939.—The density of aqueous NaOH solutions has been measured over a concentration range of from 1 to 26 molal in the temperature range 0 to 70°. The partial molal volume of the hydroxide as calculated from these measurements gives when plotted against the square root of the concentration a straight line up to a definite point at which a break occurs which shifts toward higher concentrations with increasing temperature. The values of the apparent partial molal volume of the hydroxide and the slope of the curves on either side may be calculated from the following equations:

(A) ForNaOH concentrations below the break:

$$\phi_1^0 = -10 \cdot 580 + 0 \cdot 2863t - 0 \cdot 00470t^2 + 0 \cdot 0000266t^3;$$
$$k_1 = 5 \cdot 3342 - 0 \cdot 08788t + 0 \cdot 001603t^2 - 0 \cdot 00000994t^3.$$

(B) For NaOH concentrations above the break:

$$\phi_2^0 = -3 \cdot 798 + 0 \cdot 1030t - 0 \cdot 001312t^2 + 0 \cdot 000008563t^3;$$
$$k_2 = 3 \cdot 181 - 0 \cdot 0155t + 0 \cdot 000201t^2 - 0 \cdot 00000145t^3,$$

where t is the temperature in °C. A density table similar to the one in "I.C.T." was computed using these equations. AUTHORS.

2308. Density of Single Crystals of Cupric Acetate Monohydrate. S. S. Sidhu and J. A. Berger. *J. Chem. Phys.* 7. *pp.* 322–323, *May*, 1939.—Densities of single crystals of cupric acetate monohydrate have been determined by the pycnometer method for temperatures 21·0° C., 23·5° C. and 25·0° C., and are 1·907 ± 0·001, 1·891 ± 0·004 and 1·880 ± 0·003 gm.cm^{-3}. respectively. The first one compares favourably with the value (1·906 gm.cm^{-3}.) calculated at about 21·0° C. from accurately determined lattice parameters of the unit cell and the number of molecules per unit cell. It is considerably higher, however, than the value (1·882 gm.cm^{-3}.) given in the *International Critical Tables*. AUTHORS.

2309. Density and Transition Points of Dotriacontane (Dicetyl). W. F. Seyer and W. Morris. *Am. Chem. Soc., J.* 61. *pp.* 1114–1117, *May*, 1939.—It has been shown that the dilatometer method can be used to measure accurately the transition points of solid paraffin hydrocarbons such as dicetyl. Pure dicetyl can be prepared from cetyl alcohol if sufficient recrystallisations are made. AUTHORS.

DIFFUSION AND OSMOSIS.

2310. Permeation, Diffusion and Solution of Gases in Organic Polymers. R. M. Barrer. *Faraday Soc., Trans.* 35. *pp.* 628–643, *May*, 1939.—A method has been used for measuring permeability constants, P, diffusion constants, D, and solubilities, σ, by investigating both stationary and non-stationary states of flow through polymeric organic membranes. The constants P, D, and σ were found respectively to obey equations of the type $P = P_0 \, e^{-E/RT}$, $D = D_0 \, e^{-E_1/RT}$, and $\sigma = \sigma_0 \, e^{-\Delta H/RT}$, in all cases. The values of E, E_1, ΔH, D_0 and σ_0 have been evaluated in a number of gas-polymer systems. E ranged from 6500 cal./mol. to 10,700 cal./mol.; E_1 from 8700 to 11,900 cal./mol. Heats of solution at constant pressure ranged from 500 to 2000 cal./mol. By contrast to processes of solution in organic liquids, all the gases for which solubility could be measured dissolved exothermically in the polymers. Values have been obtained for the free energy and entropy changes for the solution process at constant pressure. Because the actual solubilities in polymeric rubber-like membranes were very nearly those for organic liquids, there is little difference in the free energy of solution. There is, however, a greater decrease in entropy, by 4 or 5 entropy units, when a gas dissolved in a polymeric rubber-like membrane than when it dissolved in a liquid. This is interpreted as a greater restriction of mobility of the solute in the polymer than in a normal liquid. [See following Abstract.] AUTHOR.

2311. Activated Diffusion in Membranes. R. M. Barrer. *Faraday Soc., Trans.* 35. *pp.* 644–656, *May,* 1939.—A classification of activated diffusion systems may be made on the basis of specificity or non-specificity of the interaction between solute and medium. By non-specific interactions are implied those involving van der Waals forces only, or principally. Previous data on diffusion in rubber like polymers have been treated further: it was shown by calculation that elastic displacement on a molecular scale in a membrane can cause a large reduction in the energy barrier encountered on diffusion. For such elastic membranes the data showed that the energy of activation for diffusion is insensitive to molecular size and force field, whereas for rigid membranes, such as inorganic glasses, the activation energy is very sensitive to the molecular size of the solute. Reasons were given which attribute diffusion in rubber polymers to the presence of a statistical distribution of holes, the activation energy being very nearly the energy of hole formation. The application of formulæ for D based on kinetic theory, and the transition state theory both support the outlined theory of diffusion in rubbers. Kinetic theory treatments indicate that many degrees of freedom are involved in the supplying of the activation energy. The transition state theory gives entropies of activation greater than the entropy of solution, again indicating a considerable disturbance in the medium surrounding the solute. Both viewpoints are compatible with each other and the theory of holes as applied to solute diffusion in rubbers. Activated diffusion in rubbers corresponds to the "fast" reactions of chemical kinetics. An analysis of the constants D_0 in the equation $D = D_0 e^{-E/RT}$ [see preceding Abstract] for 80 different systems—rubbers, surface diffusions, liquids, glasses, and metallic and ionic crystals—shows that D_0 covers a range of 10^8-fold (from about 10^2 to 10^{-6}). The distribution curve, whose maximum occurred at $D_0 = 3 \times 10^{-2}$ cm^2. sec^{-1}. contained certain well-defined groups: rubbers ($D_0^{\text{max.}} = 3 \times 10^1$ cm^2. sec^{-1}.); liquids ($D_0^{\text{max.}} = 3 \times 10^{-2}$ cm^2. sec^{-1}.); crystals ($D_0^{\text{max.}} = 10^{-3}$ cm^2. sec^{-1}.). Crystals having the greatest structural diversity showed the greatest spread in D_0 (10^7-fold). Activation occurs, on an average, through fewer degrees of freedom on passing down the series rubbers, liquids, crystals. A comparison was made between the constants, D_0 of activated diffusions, and the constants k_0 (from $k = k_0 e^{-E/RT}$) of uni-molecular reactions. AUTHOR.

2312. Diffusion in Absorbing Media. P. S. H. Henry. *Roy. Soc., Proc.* 171*A*. *pp.* 215–241, *May* 19, 1939.—The diffusion of one substance through another in the pores of a solid body which may absorb some of the diffusing substance is discussed mathematically. The theory is applicable to the uptake of moisture by bales of cotton. Some of the diffusing substance is immobilised, and heat is given out in the process. The equations involved in the theory are symmetrical, and are kept linear by regarding certain variables as constants, *i.e.*, by considering only the case of small changes of concentration of the diffusing substance. It is also assumed that the amount of vapour absorbed by a given quantity of the solid in equilibrium varies linearly with the concentration of the vapour and with temperature. The diffusion constants are assumed to be independent of the amount of vapour absorbed and of temperature. The results are applied to the case of baled cotton of densities 0·2, 0·4 and 0·6 gm./cm^3. J. S. G. T.

2313. Optical Determination of Coefficient of Diffusion in a Mixture of Hg Vapour and H_2. J. L. Spier. *Physica,* 6. *pp.* 453–457, *May*, 1939. *In English.*—In a tube Hg vapour diffuses against a stream of H_2. The pressure in the tube amounts to 3 mm. Hg., the temperature is 50° C. The Hg vapour excited by means of an electric discharge emits Hg lines of various wave-lengths. From photographic measurements of this radiation the value of the coefficient of diffusion is found to be 0·53 cm^2./sec. (at 0° C.; 76 cm. Hg). These measurements were performed with nearly the same apparatus as has been employed by van der Held and Miesowicz [see Abstract 3867 (1937)]. For a more elaborate description especially of the theory, see their communication. AUTHOR.

***2314. Osmotic Pressure of Solutions of Polysaccharide Derivatives. Parts I and II. S. R. Carter and B. R. Record.** *Chem. Soc., J. pp.* 660–675, *April,* 1939.—In Part I an osmometer is described for the investigation of polysaccharide derivatives of molecular weights between 3000 and 1,000,000 in solutions of organic solvents. Semipermeable membranes are described whose permeability may be controlled over a wide range down to complete impermeability. In Part II the osmotic pressure–concentration relationship has been investigated, and in every case deviations from the van 't Hoff ideal were observed, the osmotic pressure always increasing with concentration more rapidly than demanded by the law. The magnitude of the deviation depends on the solvent; it is always greater for $CHCl_3$ than for CCl_4. Wo. Ostwald's "general solvatation equation" has been shown to offer a satisfactory mathematical representation of the relationship. Being free from "Donnan" membrane effects, the results are well adapted to the study of deviations from the ideal-solution laws. By extrapolating the Π/c–c curves to zero concentration, molecular or particle weights have been deduced. The limiting value of Π/c at zero concentration is independent of the solvent. By comparison with the size of the minimum chain lengths as determined by Haworth's end-group assay method, the particle weights of the polysaccharides are usually several times that of the fundamental chains. In the case of inulin, and possibly lichenin, the physical and the chemical units are identical. AUTHORS.

See also Abstracts 2272, 2332, 2333.

ELASTICITY AND PLASTICITY.

2315. Deformation of Square Plates of Mild Steel with Central Square Opening. A. Schreyer. *Forsch. IngWes.* 10. *pp.* 93–100, *March–April,* 1939. *English Abstract.*—The present treatise is intended to add further experimental confirmation of the plate theory. In particular, it is desired to ascertain how the provision of an opening in the plate influences the deformation and, therewith, the stress conditions.

2316. Graphical Construction for Stress. J. J. Guest. *Phil. Mag.* 27. *pp.* 445–448, *April,* 1939.—Gives a graphical construction for the stress components across any plane when the three principal stresses are known. W. G. B.

2317. Problems of Finite Strain. Part II. B. R. Seth. *Phil. Mag.* 27. *pp.* 449–452, *April,* 1939.—The problem solved is that of a hollow sphere "turned inside out." [For Part I see Abstract 1902 (1939).] W. G. B.

2318. Direct Determination of Stresses from Stress Equations. Part III. B. Sen. *Phil. Mag.* 27. *pp.* 596–604, *May,* 1939.—In this paper some two-dimensional problems connected with an infinitely large plate having a straight boundary and having different elastic properties along two perpendicular directions are solved. The method employed is the same as followed in previous parts [see Abstract 1903 (1939)]. The results involve a constant $k = \sqrt{\sigma_1/\sigma_2}$, where σ_1 and σ_2 are the Poisson's ratios for contractions along the two perpendicular directions of the axes of x and y respectively. On making k tend to unity the corresponding results for an isotropic body are obtained. AUTHOR.

***2319. Zigzag and Helical Springs ; Elastic Properties of Molybdenum. G. L. Tawney.** *Rev. Sci. Instruments,* 10. *pp.* 152–159, *May,* 1939.—A "zigzag" type of spring for supporting current-carrying filaments is described and compared with the tungsten helical type of spring. The zigzag spring is particularly useful when a combination of high current-carrying capacity and low spring constant is desired. Designs and stress analyses are deduced both for the helical and the zigzag spring, to meet a wide range of requirements. An approximation is given for the elastic limit of Mo and the rolling and annealing of Mo sheets for tube parts are discussed. AUTHOR.

2320. Plasticity and Plastic Flow of Dispersions. P. S. Roller. *J. Phys. Chem.* 43. *pp.* 457–489, *April,* 1939.—Basing plasticity on the measurement of viscosity is wrong since plasticity depends on actual deformation and not on rate of deformation. Experimentally the continuous deformation of cylindrical specimens under a uniformly increasing compressive load was measured. For most dispersions, except for an initial region, straight lines were obtained by plotting log (height of cylinder) against log (applied load). These lines are parallel for different dispersions of the same solid and liquid. Discontinuous and suspended flow were also observed. Plastic flow can thus be defined by a yield value p_0 and a coefficient of renitence κ expressing the rate of increase of plastic resistance accompanying continued plastic flow. κ is an inverse quantitative measure of plasticity. The relation of p_0, κ and the liquid retention to softness, plasticity, workability and cohesion is explained. The yield value of a dispersion is determined by the total force of attraction between the particles of the disperse phase at their initial mean distance of separation and plasticity by the total force of attraction at unit distance of separation. Intrinsic attractive force, electrokinetic potential, solvation, dispersity and particle shape affect the cohesion and plasticity in accordance with theory. The effect of rate of deformation on the plastic flow constants is small. The viscous resistance, which is small compared with the plastic resistance, may be diminished indefinitely by reducing the rate of deformation since the plastic resistance depends only on the static configuration of the plastic mass. J. B. W.

2321. Effect of Temperature on Plasticity and Rupture of Crystals. J. Ekstein. *Comptes Rendus,* 208. *pp.* 1098–1100, *April* 3, 1939.—Calculations have been made of the probability of occurrence of the abnormally large displacements from their equilibrium position of one or more atoms which causes the irregularities responsible for starting rupture or plastic sliding in a crystal (*e.g.,* of NaCl) at much below the calculated strain, using the analogy of monochromatic oscillators at the base of Einstein's specific heat theory. The result reconciles the apparently mutually contradictory results of Becker [see Abstract 1204 (1926)] and Boas and Schmid [see Abstract 3457 (1936)]. C. A. S.

***2322. Survey of Crystal Optics. J. Valasek.** *J. of Applied Physics,* 10. *pp.* 209–221, *April,* 1939.—A mathematical account is given of the phenomena of double-refraction, and the application of the results to problems in photoelasticity is discussed. The Babinet and Soliel-Babinet compensators and the Jamin interferometer, are described, and their uses outlined. J. T.

***2323. Direct Optical Measurement of Individual Principal Stresses. J. H. A. Brahtz and J. E. Soehrens.** *J. of Applied Physics,* 10. *pp.* 242–247, *April,* 1939.—Individual principal stresses are determined by measuring the absolute retardation of a beam of light passing through a transparent model subjected to a change in stress. An interferometer for this purpose, based on that of Favre, is described. J. T.

2324. Isopachic Stress Patterns. M. M. Frocht. *J. of Applied Physics,* 10. *pp.* 248–257, *April,* 1939.—The usual photoelastic patterns give the loci of equal differences of principal stresses. "Isopachic" patterns are those which give the loci of equal sums of principal stresses. A 45° prism is placed directly on the flat polished surface of the model to be tested, and the interference patterns, due to the high spots on the model which are developed by loading, are photographed. These are the isopachic patterns referred to. An advantage of the method is that the model need not be made of transparent material and the tests can therefore often be carried out on the actual constructional material which it is proposed to use. The results obtained from isopachic patterns of a steel model are compared with those obtained by the photoelastic analysis of a bakelite model and a satisfactory agreement is obtained. J. T.

2325. Application of Hardening Resins in Three-Dimensional Photoelastic Studies. M. Hetényi. *J. of Applied Physics,* 10. *pp.* 295–300, *May,* 1939.—Recent photoelastic tests made with hardening resins at elevated temperatures give confirmation of current theory for the molecular structure of these resins. The results obtained therefrom give a foundation of a new line of photoelasticity dealing with three-dimensional states of stress distribution. If a bar of phenol-formaldehyde resin is subjected to some simple loading at a temperature of about 110° C., it becomes very flexible at this temperature and remains perfectly elastic. Its final response and deformation takes place in a few seconds after the application of the load, whilst recovery is almost instantaneous after removal thereof. By slow cooling however, whilst still under load a permanently deformed sample is obtained which exhibits an isochromatic fringe pattern in polarised light corresponding to an elastic state of stress. This observation, that a permanently deformed body can exhibit an elastic stress distribution, is unusual but it may also be noted that machining, etc., will not disturb the isochromatic pattern. Thus it is concluded that the annealing procedure has created a solidified "frozen" form of elastic deformation which is completely preserved through the whole bulk of the test piece. If the isochromatic lines are due to strains in the material, their preservation will probably be due to the same particular properties of the structure of hardening resins which produced the "frozen" form of the elastic strains. The above observations should thus provide means of investigating photoelastically three-dimensional states of stress distribution. The present paper seeks to investigate these points and to explain the experimental observations on the basis of current molecular theory of heat-hardening resins. This theory is discussed in detail for phenol-formaldehyde resins. S. G. B.

2326. Propagation of Spherical Waves. L. Lecornu. *Comptes Rendus,* 208. *pp.* 1185–1188, *April* 17, 1939.—If a local disturbance is produced in an infinite perfectly elastic medium, waves are sent out which, at some distance from the disturbance are sensibly spherical. An investigation of the general equations reveals, however, that at very great distances a longitudinal wave tends to disappear, while a transverse wave retains a finite amplitude even at infinite distance. **Errata,** *ibid. p.* 1540, *May* 8, 1939. J. P. A.

2327. Strength of Organic Glasses. Part I. E. Rexer. *Zeits. f. techn. Physik,* 20. 4. *pp.* 97–102, 1939.—The general character of the breaking tests afforded by organic glasses [see Abstract 1488 (1939)] indicates them to be fundamentally inhomogenous substances and similar in this respect to inorganic glasses. A point of difference, however, between the two kinds of glass, is that the fracture surfaces of organic glasses depend very much on the experimental conditions, and on previous history; it constitutes a good differentiation test. A study is made from the nature of the fractures as to the internal structure of the glass and to the relationship between orientation and strength. H. H. Ho.

***2328. Sensitive Optical Strain Gauge. S. C. Redshaw.** *Journ. Sci. Instruments,* 16. *pp.* 150–155, *May,* 1939.—The strain gauge is capable of measuring positive and negative strains to about $1 \cdot 0 \times 10^{-6}$ on a gauge length of 3 or 4 in., having a linear calibration over a strain range of at least 500×10^{-6}. The gauge could be modified to operate on other gauge lengths. Although designed principally for the measurement of strains in masonry and metal bridges the instrument could be used for other structural experimental work. The design provides that the motion between a fixed and a movable knife edge will rotate a flexure pivot, the light from a target being reflected by means of a mirror mounted on the torque bar of the flexure pivot into a microscope unit set in the cover of the gauge. The microscope unit is fitted with a screw micrometer eyepiece. When the flexure pivot is operated by a change in the strain of the test specimen to which the gauge is attached, the position of the image of the target produced in the eyepiece is altered, the change being recorded by means of the micrometer wheel of the eyepiece. The gauge is clamped to a specimen by means of two spring loaded stirrups which pull either against hooks screwed into the specimen, or are attached to a bar passing behind it. The instrument is a self-contained unit, robust, simply adjusted and easily operated. AUTHOR.

See also Abstracts 2439, 2591.

GRAVITATION.

See Abstract 2436.

HYDRODYNAMICS AND AERODYNAMICS.

2329. Flow of Perfect Fluid. T. Sakurai. *Japanese Journ. Phys.* 8. 1. *pp.* 1–12, 1939. *In English.*—The two-dimensional flow of a perfect fluid bounded by partly curved and partly straight walls is mathematically treated. Analytical solutions are obtained by the method of conformal representation. The equations are resolved by the method of Schwarz and Christoffel, but when the expressions are too difficult for this the analytical expressions for the stream-lines are obtained by the introduction of an auxiliary variable. W. A. R.

2330. Diagram of Gas Flow in Rotating Tube. M. Roy. *Comptes Rendus,* 208. *pp.* 955–957, *March* 27, 1939.—The flow of gas in a rotating tube is discussed theoretically and the results are represented diagrammatically. J. S. G. T.

2331. Turbulent Diffusion. G. Dedebant and P. Wehrlé. *Comptes Rendus,* 208. *pp.* 1069–1071, *April* 3, 1939.—The concept of a coefficient of turbulent diffusion is associated with the concept of coefficients of correlation, introduced and systematised in the theory of turbulent flow by Taylor, de Kármán and Howarth [see Abstract 457 (1938)]. J. S. G. T.

2332. Turbulence and Diffusion. H. L. Dryden. *Indust. and Engin. Chem.* 31. *pp.* 415–425, *April,* 1939.—Modern developments in the experimental and theoretical aspects of turbulence in relation to the process of diffusion are reviewed. The concept of isotropic turbulence, its description in terms of the statistical properties designated " intensity and scale," and its experimental realisation are discussed at some length. Taylor's theory of diffusion by continuous movements is described and illustrated by his application of the theory to the diffusion of heat from a line source in an air stream with isotropic turbulence. At distances down-stream which are small in comparison with the scale of the turbulence, the diffusion depends only on the intensity of the turbulence; at large distances, the scale of the turbulence is also an important factor. Reynolds' description of non-isotropic turbulence is given in terms of mean values of products of fluctuations of the velocity components and of the methods now available for measuring these mean values in two-dimensional flow. Von Kármán's description of the scale characteristics of non-isotropic turbulence in terms of correlation tensors is briefly stated. Recent results on the mixing of jets with the surrounding air are briefly reviewed, and the essential difference between diffusion of momentum and diffusion of heat or matter (smoke, dye) is pointed out—namely, that the diffusion of momentum is affected by pressure gradients whereas no corresponding factor occurs in the diffusion of heat or matter. Hence the parallel between skin friction and heat transfer is invalid except in special cases. The practical means of securing large turbulence to promote rapid mixing is discussed as applied to continuous processing—namely, by turbulent flow in a pipe, by jets emerging in quiescent air or in a counter-current, and by turbulence in the wake of obstacles. AUTHOR.

2333. Eddy Diffusion. W. L. Towle and T. K. Sherwood. *Indust. and Engin. Chem.* 31. *pp.* 457–462, *April,* 1939.—Diffusion experiments were carried out at points 60 to 70 diameters downstream from the inlet ends of two ducts, 30·5 and 15·24 cm. in diameter, with air in turbulent flow at Reynolds numbers from 12,000 to 180,000. CO_2 and H_2 were introduced at the axis of the duct, and concentration traverses over the central third of the duct diameter were obtained at points up to 4 m. downstream. The results were interpreted in terms of the calculated values of the eddy conductivity, E, obtained by comparing the data with an adaptation of the Wilson equation for heat dissipation from a continuous-point heat source in a moving stream. The values of E obtained were of the order of 100 times the molecular diffusivity, and were the same for H_2 as for CO_2. E was found to approach an asymptote with increase in distance between injector tube and sampling traverse. The asymptotic values of E increased approximately proportionally to increase in Reynolds number. AUTHORS.

2334. Theory of Injectors. G. Flügel. *Forsch. IngWes.* 10. *VDI-Forschungsheft No.* 395. [21 *pp.*], *March–April,* 1939.—A theory of injector action for gas-, vapour- and liquid-injectors, including a theory of design of injector tubes, is developed. J. S. G. T.

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2335. Flow Phenomena in Nozzles and Orifices. P. Jordan. *Forsch. IngWes.* 10. *pp.* 88–92, *March–April,* 1939. *English Abstract.*—In recent literature dealing with nozzles and orifices, the endeavour becomes apparent to understand the measured results from the general laws of flow. Certain effects of these laws, especially those of the border-layer theory, on the flow phenomena in nozzles and orifices are demonstrated, without giving closer consideration to quantitative relations. Photographic views are discussed.

2336. Boundary Layer Equations. S. Goldstein. *Cambridge Phil. Soc., Proc.* 35. *pp.* 338–340, *April,* 1939.—The solution of the boundary layer equations for steady two-dimensional flow is briefly discussed, the cases for which $U=ce^{\alpha x}$ or $ce^{-\alpha x}$ being treated (U denoting, as usual, the velocity just outside the boundary layer). There are no solutions of the equations, in which the velocity distributions are similar for different values of x unless $U = cx^m$ or $ce^{\alpha x}$ $(\alpha > 0)$. J. S. G. T.

2337. Correlation of Rotameter Flow Rates. J. C. Whitwell and D. S. Plumb. *Indust. and Engin. Chem.* 31. *pp.* 451–456, *April,* 1939.—A method is proposed for the correlation, through one rotameter, of flow rates of liquids of varying physical properties. Using Bernoulli's equation as the basis for theoretical study of the instrument, a new method of plotting calibration data is developed. From the slopes of lines on this new plot, a value of a constant for each liquid is obtained. If this constant is plotted against the proper function of fluid properties, a single correlation is obtained for all ten of the fluids studied. The constant is not a single power function of fluid properties, as shown by the two distinct portions of the correlation line. The correlation is applied only above certain critical values of the Reynolds number; this fact, combined with experimental observations, indicates the induction of turbulence by irregularities of the float and by entrance conditions. Variation of the float density is included in the correlation. Use of the method is outlined with examples. AUTHORS.

2338. Fluid Resistance in Pipes. M. P. O'Brien, R. G. Folsom, and F. Jonassen. *Indust. and Engin. Chem.* 31. *pp.* 477–481, *April,* 1939.—Formulæ based on the theory of fully developed turbulent flow and on experiments using artificially roughened pipes are applied to extrapolated data for commercial pipes in order to obtain the equivalent roughness. Using this roughness, it is found that clean pipes do not follow a curve similar to that of Nikuradse in the transition zone between rough and smooth flow conditions. The conclusion is drawn that the turbulence theory has not yet provided a reliable generalised treatment of pipe resistance in the region important in engineering problems. AUTHORS.

2339. Direct Solution of Isothermal Flow in Long Pipes. C. F. Bonilla. *Indust. and Engin. Chem.* 31. *pp.* 618–621, *May,* 1939.—The application of dimensional analysis to the subject of fluid flow in pipes is reviewed briefly. The dimensionless ratios involved are given in terms of mass flow rate, *w*, as the most generally suitable unit for measuring flow. It is pointed out that trial-and-error solution for flow rate or pipe size is unnecessary if all of the dimensionless ratios available are made use of, and a number of different plots are presented for this purpose. Since each variable in fluid flow of this type will not appear in some one dimensionless ratio, the ratio omitting the unknown may be computed immediately, and from a plot of this ratio against any other, the latter may be read and the unknown calculated. One or two curves only can be made to cover all the possible cases. It is believed further that the complete exposition of the several dimensionless ratios involved may serve to clarify the study of fluid flow considerably. AUTHOR.

2340. Flow of Suspensions through Pipes. R. H. Wilhelm, D. M. Wroughton, and W. F. Loeffel. *Indust. and Engin. Chem.* 31. *pp.* 622–629, *May*, 1939.—Suspensions of cement rock and of Filter-Cel in water were pumped through 0·75-, 1·5-, and 3-in. pipes at measured velocities. Pressure drop data for 27-ft. lengths of pipe are presented. The apparent viscosity characteristics of all suspensions, which were determined in a rotating viscometer, are also included. The cement rock concentrations were 54 and 62% by weight; those of Filter-Cel were varied from 21 to 34%. The range of velocities extended from 0·3 to 14 ft./sec.; of pressure drops from 30 to 7200 lb./ft^2., calculated per 100 ft. of pipe. Cement rock suspensions were found to flow in two régimes which were treated as " plug " and turbulent flow. A separate correlation, involving pipe and viscometer data, is presented for each type of flow. The variables friction factor and Reynolds number are used for turbulent flow; friction factor and velocity, for " plug " flow. The apparent viscosity of Filter-Cel suspensions increases somewhat with rate of shear. By using viscosity at zero shear, all pumpable suspensions correlate on a friction factor *vs.* Reynolds number plot. Viscous and turbulent flow, but not " plug " flow is evident for this suspension. AUTHORS.

2341. Application of Wave-Propagation Phenomenon in Thermodynamics. M. Parodi. *Comptes Rendus*, 208. *pp.* 1285–1287, *April* 24, 1939.—The propagation of waves in a liquid contained in a series of tubes which also contain gas is considered. A. J. M.

See also Abstracts 2343, 2431.

KINETIC THEORY OF MATTER.

See Abstract 2382.

LENGTH, AREA AND VOLUME.

2342. Determination of Internal Volume of Steel Capillaries for Measurements with Gases. J. Kaminsky and B. E. Blaisdell. *Rev. Sci. Instruments*, 10. *p.* 151, *May*, 1939.—A correction. [See Abstract 962 (1939).]

See also Abstract

1373B. Micrometric Measurements with Electric Waves. V. Hardung.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

2343. Law of Similitude. E. F. M. van der Held. *Ned. T. Natuurk.* 6. 4. *pp.* 60–73, 1939.—The use of dimension arguments for reducing problems to those involving dimensionless constants and for constructing small-scale models in cases in which the theoretical equations are too complicated for direct handling is outlined and illustrated in the cases of heat-conduction and hydrodynamical problems. R. P.

***2344. Ott Integrator. P. Werkmeister.** *Zeits. f. Instrumentenk.* 59. *pp.* 168–172, *April*, 1939.—In its simplest form the instrument consists of two arms AB and CD connected together at C, the central point of AB and where AB = 2 × CD. The ends B and D move in a straight line in a guide EF and rollers are fitted at A and C to trace the curves. The theory of the instrument, examples of its use, and diagrams of the apparatus are given. R. S. R.

2345. Use of Sound-Film in Harmonic Analysis. L. W. Pollak. *Zeits. f. Instrumentenk.* 59. *pp.* 208–210, *May,* 1939.—Working on the lines of a sound-film reproducer, the author uses the principle of the sound-track to analyse meteorological and solar data, by constructing a sound-track which has the periodic fluctuation drawn in on it and blocked out on one side, thus obtaining the equivalent of a variable-area track, which, on reproduction, gives rise to an electrical wave-form which can be analysed in the normal way. For increased accuracy the whole film width is used, in one case the blocked wave-form being photographed sucessively with a Leica camera. L. E. C. H.

See also Abstracts 2316, 2351, 2422, 2597 and

1336B. Effects of Errors or Variations in the Arbitrary Constants of Simultaneous Equations. G. H. Dell.

MECHANICS, CLASSICAL.

***2346. Method for Indicating Speeds of Rotation. G. Morris and R. S. Silver.** *Journ. Sci. Instruments,* 16. *pp.* 149–150, *May,* 1939.—A method of indicating speed of rotation is described in which the frequency of the current generated by the rotation of a small bar of iron or mild steel, attached to the rotor and in the field of an electromagnet, is measured by a vibration galvanometer adjusted to resonance with a multiple of the required rate of revolution. AUTHORS.

MECHANICS, QUANTUM.

2347. Quantum of Length and Spin of Elementary Particles. J. Mariani. *Comptes Rendus,* 208. *pp.* 971–973, *March* 27, 1939.—It is assumed that the space in the "interior" of elementary particles has the metric $ds^2 = dr^2/(1 - r^2/a^2) + r^2 (d\theta^2 + \sin^2\theta \, d\phi^2)$. Such a space has a spherical representation in which the distance between two points has a periodicity defined by integers and an elliptic representation where the periodicity depends on half integral values. The author interprets this in terms of a quantum of length and sees in it the distinction between particles of different spin. [See Abstract 1927 (1939).] G. C. McV.

2348. Exact Solution of the Quantum Theory of Fields and the Interaction of Two Particles. G. Beck. *J. de Physique et le Radium,* 10. *pp.* 200–201, *April,* 1939.—Mathematical. W. R. A.

2349. Light Atomic Nuclei and the Hartree Model. S. Watanabe. *Zeits. f. Physik,* 112. 3–4. *pp.* 159–198, 1939.—In view of the poor approximation afforded for light nuclei by the Hartree oscillator model, an attempt has been made to find its cause. An explanation was found for the difference between the variation arising from usual oscillator eigen-functions, and the variation due to the Hartree method in general. According to the results of this paper it appears doubtful whether the present assumptions about nuclear forces are sufficient for an explanation of mass defects. Possibly a modification by the assumption of many-body forces would be of value. If the Joliot-Zlotowski mass defect for He^5 is correct, it seems certain that the force law generally used at the present time must undergo a further modification. G. O. B.

2350. Deviation from Coulomb Law for Proton. H. Fröhlich, W. Heitler and B. Kahn. *Roy. Soc., Proc.* 171*A*. *pp.* 269–280, *May* 19, 1939.—The authors have calculated the deviation from the Coulomb law of force for the proton on grounds of the mesotron theory of the nuclear particles. The effect is due to the fact that the proton spends a certain fraction of its life in a dissociated state as a neutron and a positive mesotron, the latter having an average distance from the neutron of the order of magnitude of the electronic radius r_0. The result is the following: The Coulomb attraction (for a negative point charge) goes over into a strong repulsion for distances less than about $1/6r_0$. This would lead to a shift of the hydrogen S-levels towards higher energies of the order of 1 cm^{-1}. for the 1S-level and one-eighth of this figure for the 2S-level. This is compared with recent experiments by R. C. Williams [see Abstract 4933 (1938)], on the fine structure of the D_a and H_a line which, according to Pasternack, can be explained by assuming a shift of the 2S-level by 0·03 cm^{-1}. How far these results lie within the limits of validity of present quantum mechanics is discussed. AUTHORS.

See also Abstracts 2273, 2276, 2357, 2395, 2500, 2527, 2540, 2580, 2624, 2626.

PHILOSOPHY OF SCIENTIFIC METHOD.

2351. Cause, Purpose and Economy of Natural Laws. Minimum Principles in Physics. M. Born. *Roy. Inst., Proc.* 30. 3. *pp.* 596–628, 1939. *Nature,* 143. *pp.* 357–361, *March* 4, 1939.—Geometrical and mechanical problems of "extremals" began to interest mathematicians in Newton's lifetime, and shortly after his death the metaphysical idea of purpose or economy in nature was linked up with them. The "law of reflection" and Gauss's introduction of "geodesics" are briefly referred to. The dualism between "local" and "total" laws characterising the problem of geodesics has wide application in many branches of physics. While there appears to be no objection to extremal laws of the local (differential type), those of the integral type make the modern mind uneasy. Instability associated with a minimum value of total energy due to gravitation and elasticity is strikingly illustrated in the case of a system consisting of a steel tape clamped at one end and carrying a weight at the other. Considerations of minimum energy are very useful in the interpretation of the internal structure of matter, *e.g.*, crystals. The significance of entropy is briefly discussed by means of a model; states of higher disorder have a higher probability. The problem of the brachistochrone is discussed. The idea of a minimum property of the real motion of a planet led ultimately to the idea of the principle of least action; the tangled history of the principle is interestingly told, and the motion of a "stationary" configuration is developed from the consideration of the mechanical system comprising a spring and weight referred to above. The idea of guiding purpose and economy in nature is an absurd piece of anthropomorphism. The Hamiltonian principle is an adequate formulation of the tendency to accept Laplace's universal formula as a legitimate ideal; the formula will take the form of an extremal principle because the mechanism of thought has no other way of condensing a complicated structure of laws into a short expression. J. S. G. T.

2352. Objective Character of Indiscernibility. P. Février. *Comptes Rendus,* 208. *pp.* 1137–1139, *April* 12, 1939.—It is shown that a theory which implies the indiscernibility of particles cannot be transformed into one which does not without at the same time introducing modifications that could be experimentally verified. A physical theory is assumed to have as its basic elements the results of measurements, predictions of the magnitudes of physical quantities and, lastly, physical laws expressed in mathematical equations. [See Abstract 1932 (1939).]

G. C. McV.

2353. What Has Become of Reality in Modern Physics? W. F. G. Swann. *Frank. Inst., J.* 227. *pp.* 473–496, *April*, 1939.—The author attempts to answer the question " What is real ? " A general concept such as " reality " has usually irrelevant associations which obscure its fundamental connotation. By an examination of the manner whereby we come to know things exist it is easily demonstrated that we acquire such knowledge only through our senses. Owing to the development of scientific discoveries and theories the fundamental principles underlying the mechanism of this process has becomes less and less obvious. It was thought during the last century that the motions of atoms were the ultimate reality but modern physics has overthrown this view since atomic events do not occur in harmony with their motions. The principle of relativity also showed that our mental concepts with regard to motion were false. Things that are real therefore can only be the principles which in ultimate analysis are able to harmonise all natural phenomena. There may be more than one set of such principles, in which case these may be designated as " realistic " with the term " real " applied only to that set which is known. A. M. T.

2354. The Scientist and the Philosopher. (Viscount) Samuel. *Roy. Inst., Proc.* 30. 3. *pp.* 458–480, 1939.—The separation between science and philosophy is excessive and harmful and the problem of their relations requires examination. The importance of the subject is not merely academic since philosophies of some kind are the bases of political creeds by which nations are governed Science demonstrates that man is part of nature and not outside it so that no theory of the universe can be true which is based primarily upon the faculties and processes of the mind. The nature of man's mind is irrelevant to the problems of ontology. Thus the Cartesian dichotomy between mind and nature must be discarded and philosophy should consent to reason only from premises provided by nature. The advantages which would result from the acceptance of this standpoint are illustrated by references to the idea of an inseparable space-time, the problem of colour and the philosophy of values. On the other hand scientists are becoming confused between physical and mental concepts as exemplified by the attribution of reality to " space-time, " " waves of probability," etc., and the deduction of free will from Heisenberg's uncertainty principle, and it is here that science may receive help from philosophy. There are two questions which if answered by science would greatly advance philosophy ; the first is the cause of gravitation, and the second the nature of the thought process, and some suggestions of possible lines of research are suggested. Finally the author expresses his confidence that the convergence of experimental science and speculative philosophy will yield results of fundamental importance. A. M. T.

PRESSURE.

***2355. Simple Glass Manometer for Low Pressures. R. Grigorovici.** *Zeits. f. techn. Physik,* 20. 4. *pp.* 102–104, 1939.—The manometer consists of a chamber, connected through a stopcock to the pump, in which is fitted a tube from the apparatus under test. The end of this tube terminates in a ground tapered joint to which is attached a second tube closed at its lower end by a glass membrane formed by allowing a thin-walled glass bulb to collapse in a Bunsen flame. Different thicknesses of membrane have been produced and the sensitivity found to be of the order of 0·002 Torr. per scale division, using a telescope at a distance of 2m. The calibration is not a straight line, but the slope increases as the pressure gets higher. The accuracy obtainable is about 2 or 3% and the range of pressures covered is from 0·1 to about 20 Torr. A. W.

See also **Abstracts 2435, 2564 and**
1373B. Micrometric Measurements with Electric Waves. V. Hardung.

RELATIVITY AND ETHER.

2356. Kinematical Description of a Flat Space-Time. C. Gilbert. *Phil. Mag.* 27. *pp.* 543–550, *May,* 1939.—The metric of the flat space-time is obtained by a simple transformation from the metric of special relativity. The author finds that there is a one-to-one correspondence between fundamental observers in these space-times, and that the transformation of coordinates is equivalent to a regraduation of an observer's clock-scale according to Milne's conventions. The geodesics in the space-time under discussion are found to correspond to certain of Milne's trajectories, which are supposed to give the paths of a statistical system of particles. These particles are shown to be acted on by an external force, derivable from a potential function which is a solution of Poisson's equation. AUTHOR.

2357. New Form of Gravitational Equations of General Relativity. Deduction of Wave Equations of Electromagnetic and Corpuscular Field. P. Caldirola. *N. Cimento,* 15. *pp.* 594–603, *Dec.,* 1938.—The assumption is made that Riemann's tensor R_i^j is given in the following form: $R_i^j = F_{ih} F^{jh} + k\phi_i\phi^j$ where F_{ih} is semi-symmetrical and that the tensor $G_i^j = R_i^j - \frac{1}{2}\delta_i^j R$ has the divergence zero. This last condition is fulfilled if F_{ih} satisfies Maxwell's equations and if ϕ_i is the gradient of a scalar ϕ which fulfils a generalised Klein-Gordon equation. In that case k is connected with Planck's constant, and the resulting universe has a finite curvature even in the absence of matter. The results are interpreted and it is shown that this theory brings out the wave-mechanical aspect of the electromagnetic or photon field and the force field of corpuscules and permits a symmetrical treatment of both fields. The mechanics of particles is studied in particular. L. K.

SOLUTION.

2358. Solubility of $Co(OH)_3$ Using Radioactive Co. B. N. Cacciapuoti and F. Ferla. *Accad. Lincei, Atti,* 28. *pp.* 385–388, *Dec.,* 1938.—In view of the abnormally high value (3·18 mg./l.) obtained by Almkvist using chemical methods for the solubility of $Co(OH)_3$ in water, experiments have been carried out using radioactive Co as indicator (half-life 230 days). The solubility has been investigated under various conditions; the solubility product obtained is given by $[Co^{\cdot\cdot\cdot}][\overline{OH}]^3 = S = 2{\cdot}8 \times 10^{-26}$, and the solubility is found to be 0·01046 mg./l. E. E. W.

2359. Aqueous Solubilities of Unsaturated Alcohols. P. M. Ginnings, E. Herring and D. Coltrane. *Am. Chem. Soc., J.* 61. *pp.* 807–808, *April,* 1939.—Aqueous solubilities of seven unsaturated alcohols have been determined for 20, 25 and 30°. Each of these is more soluble than the analogous saturated alcohol. Maximum solubility seems to be obtained with both the unsaturated and OH groups close to the centre of a compact molecule. The solubility also decreases with increasing molecular weight and temperature. AUTHORS.

2360. Solubility Curves of Boric Acid and Borates of Sodium. W. C. Blasdale and C. M. Slansky. *Am. Chem. Soc., J.* 61. *pp.* 917–920, *April*, 1939.—The solubilities of boric acid; of the deca-, penta- and tetra-hydrates of sodium tetraborate; of the tetra- and dihydrate of sodium metaborate and of sodium pentaborate have been determined and the values for 5° intervals between 0 and 100° tabulated. The metastable transition temperature ($10H_2O \longleftrightarrow 5H_2O$) of sodium tetraborate has been fixed at 60·8° and the stable transition temperature ($10H_2O \longleftrightarrow 4H_2O$) of the same salt has been fixed at 58·5°. The stable transition temperature ($4H_2O \longleftrightarrow 2H_2O$) of sodium metaborate has been fixed at 54°. Evidence is given that the pentahydrate of sodium pentaborate is stable in contact with its congruently saturated solutions between 10° and 100°, and at still lower temperatures in contact with solutions containing a slight excess of Na_2O. AUTHORS.

2361. Solubility of Mercuric Chloride in Aqueous Chloride Solutions. H. C. Thomas. *Am. Chem. Soc., J.* 61. *pp.* 920–924, *April*, 1939.—The solubility at 25° of $HgCl_2$ in water and in solutions of various chlorides has been determined. In the concentration range corresponding to the solid phase $HgCl_2$ the results suggest that the $HgCl_2$–Cl^- complex is similar in all cases studied. AUTHOR.

2362. Solubility and Swelling of High Polymers. J. N. Brönsted and K. Volqvartz. *Faraday Soc., Trans.* 35. *pp.* 576–579, *May*, 1939.—The equilibrium in systems consisting of polystyrene as one component and various esters of lauric acid as the other component has been investigated. The conclusion that in equilibria of such a kind one phase is a swelled mixture and the other a pure medium (ester) has been verified. The entropy of swelling is negative. The experiments are compatible with the existence of a critical point in which the solubility of the medium in the swelled phase is infinite. AUTHORS.

See also Abstract 2586.

SURFACE PROPERTIES.

2363. Test of Polanyi's Theory of Adsorption for Gases on Glass and on Charcoal. W. van Dingenen. *Physica*, 6. *pp.* 353–363, *April*, 1939. *In German.*—The essential feature of Polyani's theory is the curve of adsorption potential q against adsorption volume v. This takes the form $q = RT \ln P_0/P$, where P_0 is the saturated vapour pressure of the adsorbate and P its adsorption pressure; $v = x/\delta$, where x is the weight of adsorbate per gm. of adsorbent; δ = liquid density of adsorbate. Provided the temperature is much below critical, a given adsorbent and adsorbate should yield the same $q(v)$ curve, independent of temperature. This is found to be the case for O_2 and N_2 on two different charcoals at 90° and 95° Abs., whereas CO gives two curves for isotherms above and below 61·5° respectively, due to a phase transition at this temperature. For O_2, N_2 and H_2 on a given charcoal or glass $q \propto \alpha \propto \sqrt{a}$ approx. (α = polarisability of gas, a = its van der Waals constant), as demanded by the theory. For charcoals—porous adsorbents—the $q(v)$ curve falls much more steeply than for the non-porous adsorbent glass. S. J. G.

2364. Adsorption of Ethyl Iodide on a Plane Surface of Iron at 20°. M. H. Armbruster and J. B. Austin. *Am. Chem. Soc., J.* 61. *pp.* 1117–1123, *May,* 1939.—The adsorption of ethyl iodide on a plane surface of unreduced and reduced iron has been determined at 20° over the pressure range 10^{-6} to 1 mm. The adsorption isotherms fit Langmuir's equation and Palmer's relation only at intermmediate pressures. The coverage at apparent saturation is about 100% based on the geometric area of the sample, which indicates that the iron surface is substantially plane. Force–area curves for the two surfaces are quite different; that on the unreduced surface resembles the curves for insoluble films on water and shows a break at an area of about 30 sq. Å per molecule whereas that on the reduced surface shows no such break. Comparison of the curves with that for an ideal two-dimensional gas suggests that on the unreduced surface the intermolecular forces are predominantly of the van der Waals type whereas on the reduced surface dipole repulsion seems to be the primary factor. The molar heat of adsorption calculated from the isotherms is 11,800 cal. for the reduced iron and 12,200 cal. for the unreduced surface. Although the temperature of measurement was well below the critical temperature, no critical phenomena were observed. The possible bearing of the results on the action of inhibitors is discussed. AUTHORS.

2365. Radioactive Process for Determination of Ionic Adsorption at Crystalline Surfaces. Part I. L. Imre. *Kolloid Zeits.* 87. *pp.* 12–21, *April,* 1939.—The kinetic-radioactive method described in this paper enables the adsorption of relatively easily soluble salts to be very conveniently measured, since it is independent of the alteration of concentrations, and is based on the validity of the Langmuir adsorption isotherms. Experimental data are given for the adsorption of $Pb(NO_3)_2$ by $PbSO_4$ under various conditions. H. H. Ho.

2366. Adsorption on Heteropolar Surfaces. A. Clark and B. D. Thomas. *J. Phys. Chem.* 43. *pp.* 579–588, *May,* 1939.—The heats of wetting of SiO_2, CaF_2, $PbSO_4$, and $BaSO_4$ by water and by methyl, ethyl, propyl, isopropyl, and butyl alcohols have been determined. An explanation for the zero heats of wetting of CaF_2 and $PbSO_4$ is offered and a general theory for the adsorption of dipoles on heteropolar surfaces presented. Simple theoretical calculations of the heats of wetting of $BaSO_4$ and SiO_2 are shown to be in fair agreement with experiment. AUTHORS.

2367. Adsorption of Complex Ammonia Ions on Silica Gel. G. W. Smith. *J. Phys. Chem.* 43. *pp.* 637–646, *May,* 1939.—The adsorption isotherms of the complex ammonia ions of Ag, Ni, Cu and Zn on silica gel are determined. The adsorption of the same ions from mixtures of two, three, and four components, originally at a total concentration of 1·0 N, are also measured. In all cases the adsorption in milliequivalents per gm. of silica gel was greatest for the zinc ammine, and decreased in the following order: Zn, Cu, Ni and Ag. The time required to reach a constant state in the adsorption of silver ammine is considerably shorter than that for the divalent complex ions, and was about 4 hr. or less. In the mixtures the adsorption of each component is dependent upon the specific adsorption characteristics of the other components present, *i.e.*, it is decreased in the presence of highly adsorbable ions, and, the amount of decrease is greater the greater the adsorbability of the other components. The zinc ammine, which exhibits very strong adsorption is only slightly less adsorbed in the presence of the other ammines studied. Knowledge of the adsorption characteristics of the individual solutes, alone and in simple mixtures, enables one to predict, at least qualitatively, the behaviour in more complex mixtures of the same solutes. AUTHOR.

***2368. Surface Tension of Liquids by Weight of Falling Drops. C. Sâlceanu and H. McCormick** *Comptes Rendus*, 208. *pp*. 1278–1280, *April* 24, 1939.—The apparatus is described. Results obtained for the surface tension of 24 organic liquids are given. They are in good agreement with accepted values. A. J. M.

2369. Structure of Polished Metal Surfaces. S. Dobiński. *Phys. Zeits*. 40. *pp*. 232–233, *April* 1, 1939.—The view previously put forward [see Abstract 1459 (1937)] is maintained, and results obtained do not agree with those of Plessing [see Abstract 3980 (1938)]. Different lattice constants are found by electron diffraction for certain metals according to whether they are polished in air or under benzene, presumably due to the presence or absence of oxidisation by atmospheric O_2. The presence of oxide rings after heating *in vacuo* depends on the direction of the reaction $Me_x + O_y \rightleftharpoons Me_xO_y$: thus oxidised Cu loses its thick oxide layer and shows the Cu-structure, while Fe retains its oxide layer after heating to redness, even if the sample had previously shown Fe-structure. In reply, **E. Plessing** (*pp*. 233–234) affirms that no difference in lattice intervals is found corresponding to presence or absence of benzene during polishing. After heating *in vacuo*, unworked Fe gives the oxide pattern while unworked Ni and Cu give powder diagrams. Worked Ni and Cu give the same results as pure metals, and metals worked in N_2 or *in vacuo*, when oxidisation is improbable, give the same ring diameters as in air. E. E. W.

2370. Rubbed Films of Barium Stearate and Stearic Acid. L. H. Germer and K. H. Storks. *Phys. Rev*. 55. *pp*. 648–654, *April* 1, 1939.—Films of Ba stearate and of stearic acid on polished Cr and on SiC crystals give, after rubbing with clean lens paper, electron diffraction patterns by the reflection method. Well rubbed films give patterns of a single layer of molecules axially normal to the surface, the hydrocarbon chains of Ba stearate being the more precisely oriented, as is the case for unrubbed single layers of molecules of these substances when deposited by the Langmuir-Blodgett method. Thickness of rubbed films on Cr is found, by the Blodgett optical method, to be the same as that of unrubbed single layers of molecules. Lightly rubbed films may be thicker than a single layer, and, after rubbing, the axes of the hydrocarbon chains still stand normal to the surface, but lateral arrangement is less regular. In the case of stearic acid, molecules left on top of the first layer after light rubbing in one direction lie inclined at ~8° to the surface, point against the rubbing direction, and are arranged in crystals having a structure different from that of the film before rubbing; they are completely removed by very light rubbing in the opposite direction. N. M. B.

2371. Organic Parachors. Parts II and III. Tertiary Alcohols. K. Owen, O. R. Quayle and E. M. Beavers. *Am. Chem. Soc., J*. 61. *pp*. 900–905, *April*, 1939.—The surface tensions and parachors of 16 tertiary alcohols have been determined. The parachors are found to increase with temperature in the order of approximately 0·2% per 10° rise in temperature. The effect of substitution in trimethylcarbinol has been found to be most constitutive with the first CH_2 units added to the molecule, and to becomes more regular as the length of the carbon chains becomes greater. Values for the CH_2 groups in tertiary alcohols have been determined which yield closer agreement between the calculated and observed parachors than the values previously used. [For Part I see Abstract 133 (1939).] AUTHORS.

2372. Nature of Foam. Parts IV and V. T. Sasaki. *Chem. Soc. Japan, Bull.* 14. *pp.* 63–72, *March,* and *pp.* 107–114, *April,* 1939.—[For Part III see Abstract 1523 (1939).]

2373. Thickness of Air-Formed Oxide Films on Iron. W. H. J. Vernon, F. Wormwell and T. J. Nurse. *Chem. Soc., J. pp.* 621–632, *April,* 1939.—Estimates of the thickness of air-formed oxide films on high-purity iron and on mild steel have been derived from the chemical analysis of films stripped from the underlying metal by treatment in a solution of iodine in anhydrous methyl alcohol, in absence of air. The data, supplemented in certain cases by determination of total oyxgen in the surface film by Sloman's vacuum-fusion method, have been correlated with gravimetric determinations of oxygen taken up during exposure of air. Specimens prepared by abrasion carried, before the initial weighing, 1·5 μg. of oxygen per sq. cm. of apparent area. It was concluded that this was present as discontinuous ferric oxide in a matrix of iron, the total thickness of heterogeneous material being 140 Å (calculated on the apparent area of specimen) or 56 Å (on the estimated " real " area). Films stripped from specimens heated to the first-order blue (275°) incorporated this primary oxide, but from specimens heated to the first-order straw-colour (225°) only oxide formed during the period of heating was removed. The following values were obtained for total thickness of material—including continuous " secondary " film and heterogeneous primary layer beneath. First-order straw: 350 Å. (apparent area), 140 Å (estimated real area). First-order blue: 590 Å (apparent area), 240 Å (estimated real area). AUTHORS.

2374. Very Dilute Protein Films. Attempt to Determine their Molecular Weights. J. Guastalla. *Comptes Rendus,* 208. *pp.* 1078–1080, *April* 3, 1939.—The surface pressure of thin films of very dilute solutions of ovalbumin, hæmoglobin, and gliadin has been determined as a function of concentration by means of a surface micromanometer. Assuming the films to obey the gas laws the values obtained for the molecular weights are: ovalbumin, 40,000, gliadin, 27,000, hæmoglobin, 12,000. The first two are in agreement with the results of Svedberg, but the small value obtained for hæmoglobin seems to indicate decomposition of the molecule. A. J. M.

2375. Protein Films. I. Langmuir. *Roy. Inst., Proc.* 30. 3. *pp.* 483–496, 1939.—In the introduction the author indicates some of the characteristics of proteins and considers the evidence for a high degree of organisation in their structures. Then the mechanism of monomolecular film formation is explained and the technique of studying them is described. In particular the production and investigation of protein monolayers on water is discussed and finally the author shows how these films can be deposited on to solid surfaces. J. I.

2376. Pressure-Area Relations of Fatty Acid and Alcohol Monolayers. G. C. Nutting and W. D. Harkins. *Am. Chem. Soc., J.* 61. *pp.* 1180–1187, *May,* 1939.—The pressure-area relations have been determined for monolayers of the fatty acids, with from 14 to 20, and of the alcohols from 14 to 18, C atoms per molecule. The temperature regulation was more exact than has been attempted previously, to 0·01° in the subsolution and to within 0·1 to 0·2° in the air above it. Contrary to what has been found by others the molecular areas in the condensed liquid films decrease with the length of the hydrocarbon chain. From 16 to 20 C atoms the limiting areas at zero film pressure are for the fatty acids, respectively, (26·75), 24·59, 24·41, 24·00, and 23·64 sq. Å. The value in parentheses may exhibit some influence of the intermediate type of film, but the others are truly condensed. This indicates that the van der Waals energy increases with the length of chain, and draws the molecules closer as the intermolecular attraction increases. In the solid plastic state the hydrocarbon chains are so closely packed that the corresponding effect is very small. The limiting molecular areas at zero pressure are for the alcohols at 20° very close to 21·9 sq. Å, and this value is almost constant for hydrocarbon chains between 14 and 18 C atoms. The areas of the liquid monolayers at higher pressures are therefore determined by the change from 21·9 sq. Å as regulated by the compressibility of the film. The pressure of the transition point liquid → plastic solid increases from 6·2 dynes per cm. for the 14 C to 12·2 dynes per cm. for the 18 C alcohol at 20°, but the corresponding values for the acids at 25° are much more constant, since they increase only from 21 to 24 dynes per cm. from 15 to 19 C atoms. [See Abstract 4825 (1938) and following Abstract.]

AUTHORS.

2377. Viscosity of Long Chain Fatty Acid Monolayers. E. Boyd and W. D. Harkins. *Am. Chem. Soc. J*, 61. *pp.* 1188–1195, *May*, 1939.—The viscosity (σ) of monolayers of long chain acids on aqueous subsolution has been measured. With condensed liquid films the increase in logarithm of the viscosity is proportional to the film pressure. Eight important relations are listed. The experimental results are compared with theories of viscosity in three dimensions, and particularly with the two-dimensional theory of Moore and Eyring. [See preceding Abstract.]

2378. Adhesion in Detergence. R. C. Palmer and E. K. Rideal. *Chem. Soc., J. pp.* 573–577, *April*, 1939.—The adhesion of particles of carborundum and calcium carbonate to quartz surfaces is examined in the presence of dilute solutions of various detergents. The results are expressed in terms of von Buzágh's adhesion number. Both cell wall and particle surface could be rendered hydrophilic or hydrophobic at will. It is shown that adhesion is decreased for low concentrations of detergent, but when micelle formation commences the adhesion number rises again.

AUTHORS.

See also **Abstracts 2283, 2305 and**

1298B. Theory of Lubrication. Part IV. F. Morgan and M. Muskat.

TIME.

See **Abstract 2429.**

VISCOSITY AND FRICTION.

2379. Charts and Tables for Flow Produced by Circular Motion of Circular Cylinder in Viscous Fluid. T. Sakurai. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 118–137, *March*, 1939. *In English.*

2380. Rotation of Cylinder in Viscous Fluid. Part II. T. Sakurai. *Japanese Journ. Phys.* 8. 1. *pp.* 13–27, 1939. *In English.*—An equation is developed to represent the motion of a viscous fluid in which an elliptic cylinder rotates slowly and steadily about its axis. A corresponding expression for the evaluation of the resistance, and other quantities near to the surface of the cylinder, is also found. It is assumed that the sixth power of the eccentricity is negligible. [For Part III see Abstract 1010 (1939).] P. H. B.

2381. Friction on Disc Rotating within Cylinder of Liquid. T. Okaya and M. Hasegawa. *Japanese Journ. Phys.* 8. 1. *pp.* 29–38, 1939. *In English.*—A mathematical treatment of the rotation of a disc (rad. *a*) in liquid in a shallow cylinder (rad. *b*; $b \bumpeq a$). By integrating the appropriate equations of motion expressions are found in terms of *b*/*a* for the thickness of the boundary layer on the disc or on the base of the cylinder, for the ratio of the angular velocity of the disc to that of the fluid outside the boundary layers, and the coefficient of friction due to viscosity, both for the turbulent and non-turbulent conditions. P. H. B.

2382. Representation of Viscosities of Binary Gas Mixtures by Mixture Formula of Kinetic Theory. E. Schröer. *Zeits. f. phys. Chem.* 43. *Abt.B.* 2. *pp.* 103–110, 1939.—Adsumi's measured values of the viscosities of mixtures of pairs of gases including H_2 [see Abstract 3432 (1937)] do not agree well with the values calculated by the author's theoretical formula [see Abstract 109 (1937)]. This is explained as due to impurities in the H_2 used. In support of the validity of the theoretical formula measurements by Kleint on the systems H_2–O_2, H_2–N_2, and N_2–O_2 are adduced: here the agreement with the theory is satisfactory. L. A. W.

2383. Viscosity of Slag Systems. J. R. Rait, Q. C. M'Millan and R. Hay. *Roy. Techn. Coll. Glasgow, J.* 4. *pp.* 449–466, *Jan.*, 1939.—Results are given for the binary systems CaO–SiO_2 and MnO–SiO_2, and for the ternary system CaO–Al_2O_3–SiO_2. A pronounced minimum occurs in the viscosity/composition isothermal curves at the compound CaO–SiO_2. Furthermore, the viscosities of the binary system MnO–SiO_2 and of the ternary system do not appear to be a continuous function of composition. [See Abstract 1877 (1938).] AUTHORS.

2384. Physical Property-Temperature Relationships of Glass. Part I. Viscosity. E. Seddon. *Soc. Glass. Technol., J.* 23. *pp.* 36–72, *Feb.*, 1939.—The variation of viscosity over wide ranges of temperature is studied for glasses having varying degrees of complexity and for comparison materials of known internal structure, such as water, molten salts, molten or liquid metals, alcohols, paraffins, as well as other organic liquids representing simple molecular types. Values for the group-binding energy E_η and the term regarded as being connected with effective particle size $\tau_0'/a\delta^2$ are derived for each of the above glasses and comparison materials at varying temperatures using the theoretically-derived viscosity-temperature equation of Frenkel modified by the present writer to suit conditions of changing cluster size. The data derived enable conclusions to be reached regarding the internal structure of substances in the vitreous state. AUTHOR.

2385. Viscosity of Steam. H. Speyerer. *Forsch. IngWes.* 10. *pp.* 100–102, *March–April*, 1939. *English Abstract.*—Greatly divergent views prevail on the subject of the influence of pressure on the viscosity of steam. This problem of general interest is considered on the strength of the latest research results.

2386. Viscosity in Binary Liquid Systems. L. H. Bird and E. F. Daly. *Faraday Soc., Trans.* 35. *pp.* 588–592, *May*, 1939.—Samples of tetralin, *cis* decalin and *trans* decalin of a fairly high standard of purity have been prepared and a selection of observed physical constants tabulated. Viscosity measurements on a series of binary mixtures have led to the derivation of a semi-empirical mixture viscosity equation as a modification of Macleod's viscosity equation. Polarisation measurements made for mixtures containing tetralin have been used in discussing the validity of the viscosity equation. AUTHORS.

2387. Viscosity of a Liquid and Vapour Concentration. G. W. Marks. *J. Phys. Chem.* 43. *pp.* 549–559, *May*, 1939.—Empirical and theoretical expressions are given showing the relationship between viscosity or fluidity and vapour pressure or vapour concentration. A semi-empirical equation is deduced for the variation of fluidity with absolute temperature. Theoretical relationships are given concerning the fluidity of solutions. AUTHOR.

***2388. Concentric-Cylinder Motor-Driven Viscometer. R. H. Wilhelm and D. M. Wroughton.** *Indust. and Engin. Chem.* 31. *pp.* 482–486, *April*, 1939.—The design of a motor-driven concentric-cylinder viscometer is presented. The essential features of the instrument are continuous operation at a series of speeds, dynamometer mount of the motor which eliminates friction to a large degree, and accurate speed measurement by means of a simple stroboscopic device. The viscometer was calibrated in both the viscous and turbulent ranges by means of glycerol-water solutions. This calibration is presented as a specific friction factor *vs.* Reynolds number plot. The necessity of providing baffles on the wall of the outer stationary cylinder for stable operation, as well as the influence of these baffles on the shape of the calibration curve, is pointed out. The instrument was developed to measure properties of certain suspensions, but it is also useful for measuring the viscosities of liquids. This paper deals with the latter application. AUTHORS.

2389. Effect of Electric Field on Viscosity of Liquids. H. Menz. *Ann. d. Physik*, 34. 8. *pp.* 740–760, *April*, 1939.—The effect of a strong electric field on the viscosity of polar liquids has been investigated, using a capillary viscometer. In the case of the liquids examined (C_6H_6, $(C_2H_5)_2O$, C_6H_5Cl, and CCl_4) the effect produced was largely dependent on the degree of purity of the liquid. With the most carefully purified and dried liquids the effect of the field on the viscosity was less than the experimental error. With $(C_2H_5)_2O$ and C_6H_5Cl the addition of hydrogen and hydroxyl ions caused a slight increase in the viscosity. In a direct field impure preparations showed a polarisation effect, and a dependence of viscosity on the field strength. In the alternating field the effect was dependent on frequency. It is concluded that no measurable effect on viscosity due to orientation of polar molecules or groups of molecules in the field was present. It is supposed that two opposing ionic effects account for the results. These are: (1) a decrease in viscosity due to heating of the liquid by the current, and (2) an increase in viscosity due to motion of ions in the field at right angles to the direction of flow. The number of these ions depends on the purity of the liquid. A. J. M.

See also **Abstracts 2377, 2439 and**
1375B. Torsion Pendulum Instrument for Measuring Internal Friction. J. T. Norton.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2390. New Radcliffe Observatory. H. Knox-Shaw.** *Roy. Astron. Soc., Occasional Notes, No.* 4. *pp.* 45–52, *March*, 1939.—The telescope turret, for greater rigidity is built in its lower part of brick, and this is surrounded by a sheath of metal lathing with the result that the daily range of temperature is less than 1° F. within it, below, and 7° F. at telescope level. The large pyrex glass mirror will be 76 in. in dia. with a clear aperture of 74 in.; it will be aluminised at Pasadena. The telescope will have 3 foci—Newtonian, Cassegrain and Condé, and for this, 5 secondary mirrors of fused silicon are provided, and will be aluminised; at the 3 foci, the image of the moon will be about 3, 12, and 19 in. in dia. A motor drive will be substituted for a weight-driven clock and governor; this will be of the McMath-Hulbert Observatory form, with however a low-frequency tuning fork in place of the thermionic oscillator as the standard frequency. The differential motion for star-trailing is effected by a special system of gears. Five plates are given. A. S. D. M.

***2391. Simple Wedge-Photometer for Observing Bright Chromospheric Eruptions with a Spectro-Helioscope. H. W. Newton.** *Roy. Astron. Soc., M.N.* 99. *pp.* 463–466, *March*, 1939.—A description is given of a simple wedge-photometer intended especially for the rapid measurement of intensities of bright chromospheric eruptions observed with a spectrohelioscope. The wedge comparison is made directly in the field of view between the bright area as seen in $H\alpha$ and the continuous spectrum, 15 Å away from the centre of $H\alpha$, coming from a contiguous region of the disc. This juxtaposition in the field of adjacent areas of the sun seen respectively in $H\alpha$ and in $H\alpha \pm 15$ Å is effected by introducing into the optical train a thick secondary line-shifter half the height of the primary one. AUTHOR.

COMETS AND METEORS.

2392. Evolution and Origin of Comets. S. V. Orlov. *Astron. J. of Soviet Union*, 16. 1. *pp.* 3–27, 1939. *English Abstract.*—The primary orbits of comets, *i.e.*, those along which they approach the solar system, being at such distances that perturbations from individual planets may be neglected, should be considered elliptical. The condensation of aphelion directions is best explained by assuming that comets break up and form new groups with similar orbital elements. The collision of cometary nuclei with meteorites is introduced as a new factor. At the velocity of such collisions explosions may occur in the comet nuclei, causing sudden outbursts of cosmic dust and of small fragments. This explains the structure of dust trains, and the slow disintegration of cometary nuclei into meteor showers. Study of the photometric curve of Halley's comet gives it a lifetime of the order of 10^5 years. It follows that comets are much younger than planets. The author suggests that the old hypothesis of Langrange on the origin of comets is still the most probable one. A. HU.

2393. Meteors and the Stratosphere. I. S. Astapowitsch. *Astron. J. of Soviet Union*, 16. 1. *pp.* 28–41, 1939. *English Abstract.*—Stratosphere structure is examined by means of the temperature function $T(H)$ of height H. Values of the relative density p_a/p_d at the points of appearance and disappearance of a meteor are obtained as functions of its heat capacity and evaporation temperature. Study of the propagation of its sound wave then permits calculation of $T(H)$, whence the speed of diffusion of its trail allows the relative density of the air to be found. Examination of the drift of meteor trails and of noctilucent clouds is suggested as the best means of studying the direction and velocity of air currents at 20–80 km. (dust streaks), 80–82 km. (luminous clouds), and 80–120 km. (gaseous streaks). Meteor spectroscopy as yet affords no possibility of determining the pressure and chemical constitution of the atmosphere at these heights. A. Hu.

COSMOGONY.

2394. Observable Relations in Relativistic Cosmology. Part II. W. H. McCrea. *Zeits. f. Astrophysik*, 18. 2. *pp.* 98–115, 1939. *In English.*—Recent observations show that the assumption that the universe is isotropic and homogeneous, which forms part of current theories of the "expanding universe," is probably not satisfied by the actual universe. This paper is an attempt to discover the type of relation which must hold between observable quantities if the theory of general relativity is applicable but if the assumption of isotropy and homgeneity is not made. It is first shown that Hubble's law, or something of a very similar character, must hold to a first approximation, independently of the distribution of matter. In order to relate the apparent recession of the nebulæ to the distribution of matter, it is necessary to proceed to higher approximations in its relations to distance. With a certain relativistic representation of the universe in our neighbourhood, it is shown how the second approximation in the dependence of the apparent recession on distance can in fact be related to the mean density in our neighbourhood, whether or not the distribution is homogeneous or isotropic. The problem of expressing this relation in terms of quantities which are observable by astronomical methods is discussed, but is not completely solved. [For Part I see Abstract 1480 (1935).] Author.

2395. Wave-Mechanics and Stellar Theory. Part II. H. Jehle. *Zeits. f. Astrophysik*, 18. 2. *pp.* 116–123, 1939.—The wave-mechanical conception of stellar statistics developed by the author in an earlier paper [see Abstract 2320 (1938)] will not be free from internal contradiction unless it can be shown to be compatible with classical mechanics. In this paper such compatibility is established. A number of corrections to and remarks on the previous paper are given. A. Hu.

2396. Tidal Theory of Origin of Solar Planets. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 27–36, *March*, 1939. *In English.*—The tidal theory of the formation of planets due to Chamberlin and Moulton is investigated mathematically under the assumption that the external star, producing the tidal disturbance in the sun, remains at a constant distance from the latter whilst the intensity of the tidal force varies with the time. It is also assumed that the sun is incompressible. It is proved that in such an encounter, a free vibration of the sun can be excited and that the amplitude of the vibration is a maximum when the relative velocity of the encounter is fairly small. G. C. McV.

2397. Relativistic Cosmology. G. Temple. *Phys. Soc., Proc.* 51. *pp.* 465–478, *May*, 1939.—The basis of the theories of relativistic cosmology is reviewed. The assumption of the uniformity of physical laws may be interpreted by saying that space-time in' the large is geometrically the same as space-time in the vicinity of the observer or by saying that the local space-times near each observer are alone identical. The fundamental hypothesis of homogeneity together with the first interpretation leads to Milne's theory which is equivalent to special relativity. The second interpretation leads to the expanding universes of general relativity. The methods of arriving at the line-element for the part of space-time occupied by nebulæ are discussed as well as the establishment of Einstein's field equations. It is shown that space-time is stratified so that the world-lines of the nebulæ are orthogonal to a system of three-dimensional manifolds. The possibility that the coordinate-systems commonly used in relativistic cosmology may not in fact cover anything more than the region of space-time containing the nebulæ is pointed out. G. C. McV.

2398. Observation and Theory in Cosmology. G. C. McVittie. *Phys. Soc., Proc.* 51. *pp.* 529–538, *May,* 1939.—The determination of the unknown constants in the line-element of space-time from observations of the red-shifts and the numbers of extra-galactic nebulæ is discussed. Hubble's semi-empirical formulæ for red-shift and number of nebulæ as functions of apparent magnitude, hitherto used as the starting point in such investigations, are shown to imply arbitrary assumptions that greatly restrict *a priori* the choice of model for the universe. A new method is therefore developed for comparing theory and observation which does not make use of such *a priori* restrictions. It is concluded that space is an infinite hyperbolic space of radius 10^8 or 10^9 parsec, that the average density of matter is about 10^{-29} gm./cm^3. and that the average effective temperature of the nebular radiation lies between 5000° and 7500°. G. C. McV.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2399. Apsidal Motion in Binary Stars. T. E. Sterne. *Roy. Astron. Soc., M.N.* 99. *pp.* 451– 462, *March,* 1939.—The secular motion of the apse in the orbits of binary stars whose components are assumed to be composed of compressible fluids, is found in the limiting case where the orbital period is long compared with the free harmonic periods of the components. Account is taken of the variation of the tidal deformations with time. Terms of an order up to but not including the tenth power of (a_i/A), where the mean radii are a_1 and a_2 and the semi-major axis of the relative orbit is A, are retained in the final results. The orbital eccentricity, e, enters the analysis exactly through functions which are represented by closed expressions valid for all values of e less than unity. The motion is found to be a precession, and the results are the same as Cowling's [see Abstract 4835 (1938)] to his order of accuracy, which includes terms of the fifth order in (a_i/A). The present more complete results, which are given in a form applicable to all models, lead to still higher degrees of central condensation than Cowling's when (a_i/A) is not very small. The superficial tidal and rotational distortions are found incidentally, in forms applicable to all stellar models. For given stellar models, masses, a_i's, rotations, and A, the predicted apsidal precession increases rapidly with e and approaches infinity as e approaches unity. AUTHOR.

2400. Collisions in 3-Body Problem and in Space. D. Belorizky. *Comptes Rendus,* 208. *pp.* 966–969, *March* 27, 1939.—Expansions in terms of the time for the (complex) rectangular coordinates of the body of negligible mass in the field of two bodies describing circular orbits are given, the motion being near a collision in which the distance of the small body from each of the other two is zero. The collisions occur at critical algebraic points. Corresponding results for the general problem are given and the number of arbitrary constants in the solutions is discussed.

G. C. McV.

2401. Effect of a Circular Ring on Perihelion and Node of Planet's Orbit. J. Chazy. *Comptes Rendus*, 208. *pp.* 1375–1379, *May* 1, 1939.—The approximately circular motion of a particle in a gravitational field with axial symmetry has been studied by direct methods by Fatou. The classical method, using the osculating elements, is now used to find the small motion near an equilibium position. Formulæ for the advance of the node and of the perihelion are thus obtained. G. C. McV.

NEBULÆ.

2402. Distribution of Position Angles of Extra-Galactic Nebulæ in Horologium. F. G. Brown. *Roy. Astron. Soc., M.N.* 99. *pp.* 534–535, *April*, 1939.—Position angles of elongated galaxies in the Horologium region show a fourfold preference for values round about 33° over the direction at right angles to this. Other less well-observed regions appear to show similar preferential distributions of the position angles. AUTHOR.

2403. Expansion of Crab Nebula. J. C. Duncan. *Astrophys. J.* 89. *pp.* 482–485, *May*, 1939.—The expansion of the Crab nebula, revealed in 1921 [see Abstract 503 (1922)] by a comparison of the positions of twelve nebulous points on photographs made with the 60-in. telescope with an interval of 11·5 years, is now studied by observing 20 points on photographs made with the 60-in. with an interval of 29·1 years. On the assumption that the observed nebulous points started simultaneously and that each has moved with uniform velocity, the point from which the expansion takes place is located 20″ following and 2″ south of the northern component of the central double star, and the date of the outburst is indicated as A.D. 1172. The observed angular motions, together with the radial velocities published by Mayall, indicate for the nebula a distance of about 4200 light-years and a major axis of about 6. There is evidence that the nebula has a proper motion of 0·037″ per year, corresponding to a velocity across the line of sight of 230 km./sec. The south component of the central double star has a proper motion of 0·019″ per year, while the north component is sensibly stationary. A twelfth-magnitude star situated 5·8′ north-preceding the nebula has the conspicuous proper motion of 0·240″ per year. AUTHOR.

See also Abstract 2407.

PLANETS.

2404. Identification Table of Minor Planets. G. Stracke. *Preuss. Akad. Wiss. Berlin, Abhandlungen, No.* 4. [109 *pp.*], 1938.—The tables cover in all 4744 minor planets discovered since 1801; the previous issue in 1926 covered less than half this number. Table I gives a chronological survey of all planet discoveries since 1801. Table II records observers in alphabetical name order and the number of planets discovered by each observer. Table III gives the name and designation of the 1433 numbered planets. Table IV gives a list of the special designations introduced by particular observatories and the equivalent new designations. Table V comprises a key to the enumeration of planets 333 to 1433.

J. E. K.

See also Abstracts 2396, 2405, 2406, 2654.

STARS.

2405. Determination of Stellar Diameters. J. D. Williams. *Astrophys. J.* 89. *pp.* 467–471, *May*, 1939.—It has been suggested at various times that the angular diameter of a star may be deduced from a study of its light-curve while it is undergoing occultation by the moon; but Eddington has shown that observation of the geometrical occultation is almost hopelessly complicated by diffraction effects, except for stars of very large angular diameter. The present paper points out that the diameter may be deduced from the diffraction effect itself, and the question is discussed quantitatively. [See following Abstract.] AUTHOR.

2406. Photoelectric Observation of Diffraction at the Moon's Limb. A. E. Whitford. *Astrophys. J.* 89. *pp.* 472–481, *May*, 1939.—The occultations of β Capricorni and ν Aquarii on Sept. 6 and 7 (respectively), 1938, were observed with the 100-in. telescope and a fast photoelectric system. The record was obtained by photographing the screen of a kathode-ray tube with a moving-film camera. An analysis of the unavoidable noise present in amplifiers predicted fluctuations of approximately the magnitude observed, about 4% of the brightness of β Capricorni. A calculation of the diffraction effects to be expected was carried out, with allowance for the wide range of wave-lengths used. The observations were in satisfactory agreement with the calculation. The stars were not large enough to change the diffraction pattern from that due to a point source by an observable amount. Therefore, no information on stellar diameters was obtained. With stars of angular diameters greater than 0·005″, the method can be used to measure stellar diameters. [See preceding Abstract.] AUTHOR.

2407. Observations Made with the Nebular Spectrograph of the McDonald Observatory. Part II. O. Struve and C. T. Elvey. *Astrophys. J.* 89. *pp.* 517–525, *May*, 1939.—A series of spectrograms in Monoceros and Canis Major reveal a number of new emission nebulosities, some of which seem to be unrelated to any individual stars while others form distinct groups which are related to O or B stars. A spectrophotometric study of $H\alpha$ and $H\beta$ in the outer loop of Orion near BD + 1°1126 gives $n_4 = 100$ cm^{-2} and $n_3 = 90$ cm^{-2}. It is estimated that the faintest recorded emission nebulosities have ten times fewer atoms per cm^2. in the fourth and the third energy-levels of H. This agrees satisfactorily with former estimates. [For Part I see Abstract 583 (1939).] AUTHORS.

2408. Stellar Motions (Progress of Astronomy Reports). J. H. Oort. *Roy. Astron. Soc., M.N.* 99. *pp.* 369–384, *Feb.*, 1939.—Up to the distances of the farthest observed Cepheids (about 2500 parsecs in the galactic plane) the observed motions are well represented by the first-order terms of the differential galactic rotation. It is a simple rotation probably about the material centre (distant about 8000 ps.). Some 67 RR Lyræ-type variables have very high velocities and may give the lower limit of the velocity of escape from the galaxy. The peculiar motions of faint O–B stars show a decidedly ellipsoidal distribution. The Radcliffe faint star motions indicate the star-streaming to extend unaltered to 1500 ps. Interstellar gas has a peculiar velocity *not* due to galactic rotation. A correction of about 0·010″ per annum is found to Newcomb's precession constant. Globular clusters do not partake in galactic rotation. It is probable that the southern B-star group could not have existed in its present form for more than 10^8 years; and from the condition of existing clusters, Bok estimates that 2×10^{10} years is an upper limit to the age of the galaxy. A. S. D. M.

2409. Stellar Kinematics and Mean Parallaxes. F. K. Edmondson. *Roy. Astron. Soc., M.N.* 99. *pp.* 525–533, *April,* 1939.—The mean parallaxes in the 0°–10° galactic zone which have been determined at the McCormick Observatory by van de Kamp and Vyssotsky are not consistent with star counts. It is possible that the inconsistency is due to the systematic and accidental errors of the proper motions, but it seems desirable to examine the possibility of other explanations. The possibility of a change of the luminosity function is examined and ruled out. The possibility of a second-order galactic-rotation effect is examined. Such an effect seems to exist in both the tau- and the upsilon-components, although it is nearly at the limit of statistical significance. Some confidence in the reality of the effect should be inspired by the consistent values of the second-order coefficient derived independently from both components of proper motion. The existence of the second-order terms can be checked by observing radial velocities of faint stars in low latitudes. At the 12th magnitude, first and third harmonics are expected with amplitudes of −15 and −10 km./sec. The significance of a second-order effect of the observed size is discussed. [See Abstract 3006 (1937).] AUTHOR.

2410. Proper Motions in Galactic Cluster NGC 752. E. G. Ebbighausen. *Astrophys. J.* 89. *pp.* 431–444, *April,* 1939.—First-epoch plates were taken by Trumpler at Allegheny in 1915–1918; the second-epoch plates average 20·9 years later at Yerkes, and of these, each was taken at the same centre as its former, but exposed through the glass. As the p.m. of the cluster is small relative to the non-cluster stars, the problem of separating the two requires a high degree of accuracy. The methods and sources of error are described. A plate, 4 diagrams and 4 tables are given; one diagram shows the spectrum-magnitude [see Abstract 4403 (1937)]. The absolute photographic magnitude of the maximum in the cluster is about +2·2, differing greatly from other galactic clusters and from stars in general The absolute proper motion is 0″.012/year in about 160° agreeing with that given by meridian positions. A. S. D. M.

2411. Colour of P Cygni. F. Sherman and W. W. Morgan. *Astrophys. J.* 89. *pp.* 509–516, *May,* 1939.—From a comparison of colour excesses of stars near P Cygni and located at about the same distance from the sun, it is found that the colour excess of P Cygni is partly due to interstellar reddening and partly to conditions in the immediate neighbourhood of the star itself. Attention is called to a systematic progression of determinations of colour excesses apparently depending on the range of wave-lengths observed. AUTHORS.

2412. Space Reddening Deduced from Moving Cluster in Perseus. E. G. Martin. *Roy. Astron. Soc., M.N.* 99. *pp.* 467–470, *March,* 1939.—The B-type stars in the Perseus-Auriga region are separated into two groups, near and more distant, by proper motions and parallaxes. The separation is confirmed by Stebbins's colour measures and by Greenwich spectrophotometric determinations. A selective absorption is derived and results are given of other investigations for both general and selective absorption in this region. AUTHOR.

2413. Intensity of Mg 5183 in K-type Stars. A. D. Thackeray. *Roy. Astron. Soc., M.N.* 99. *pp.* 492–498, *April,* 1939.—Photometric measures of intensity of Mg 5183 in 41 stars of type G5 to K6 show that the line is very sensitive to surface gravity, increasing more than twofold in equivalent width from supergiants to dwarfs of type K0. The Mg "*b*" triplet might prove useful in detecting dwarf characteristics on very low dispersion. The D lines (Na) and Fe 5269 are insensitive to absolute magnitude (comparing giants and dwarfs of the same type); Mg 5528 is probably stronger in dwarfs than giants, while an apparent strengthening in supergiants may be due to a Sc^+ blend. The behaviour of Mg 5183 is at variance with ionisation theory. Various possible explanations are considered. AUTHOR.

2414. Collisions and Theory of Radiative Equilibrium. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.*99. *pp.* 478–491, *April*, 1939.—The paper discusses the effect of collisions between electrons on the type of radiative equilibrium to be expected in the outer layers of a star and arrives at the conclusion that local thermodynamic equilibrium is substantially maintained by them. It is shown by developing the theory of a gradual change from local thermodynamic equilibrium to monochromatic radiative equilibrium and comparing the results with Abbott's observations of darkening to the limb that the terms representing monochromatic radiative equilibrium must be small, in agreement with the microscopic analysis. AUTHOR.

2415. Stellar Physics. E. Sevin. *Bull. Astronomique*, 11. 5–6. *pp.* 233–312, 1938.—The paper is a monograph on the present state of astrophysics, and in particular on current theories of stellar constitution, radiation, equilibrium, and evolution. The development of the theory is traced from Emden's treatment of polytropic equilibrium, through Bialobrzeski's introduction of radiation pressure, to Eddington's conception of radiative equilibrium. The mathematical and physical natures of stellar equilibrium are compared, and possible sources of stellar energy discussed. The evolution of cosmic matter is traced from the pre-stellar era of nebulæ to a stellar era in which four stages are distinguished: a pre-primary epoch, containing giants (*e.g.*, Capella A and B); a primary epoch, mainly principal-series stars characterised by constancy of central temperature (*e.g.*, Algol, Sirius A, the sun); a pre-secondary epoch, a stage in which stellar matter is being transformed into neutrons (*e.g.*, Krueger 60 B, o_2 Eridani B); and a secondary epoch in which this transformation is complete (*e.g.*, Sirius B). A. HU.

2416. Pressure Relations in Interior of Stellar Bodies. N. R. Sen. *Zeits. f. Astrophysik*, 18. 2. *pp.* 124–131, 1939. *In English.*

2417. Physical Possibilities of Stellar Evolution. G. Gamow. *Phys. Rev.* 55. *pp.* 718–725, *April* 15, 1939.—The evolution of gaseous bodies, caused by different physical processes happening in their interior and serving as energy-sources, is considered qualitatively and partially quantitatively in view of possible applications for the explanation of various observed states of known stars. It is shown that the part of evolution during which the main source of energy is given by thermonuclear reactions leads to a steadily increasing luminosity and goes over continuously into the contractive stage where the energy liberation is purely gravitational. The later stages of contraction and the transition into the state of degenerate gas model are discussed, in application to the present state of white dwarfs. Some remarks are made about the possibility of neutron-core formation in heavier stars, in application to the explosion-phenomena observed in supernovæ. An attempt is made to explain the energy production in red giants as due to thermonuclear reactions of light elements (lithium, beryllium, and boron), and the pulsation-phenomena observed for Cepheid variables is interpreted as due to instability during the transitions from the giant branch into the main sequence. AUTHOR.

2418. Highly Collapsed Stars. F. Zwicky. *Phys. Rev.* 55. *pp.* 726–743, *April* 15, 1939.—The general relativistic solution of the problem of a homogeneous sphere of constant density is discussed. For every given density a characteristic mass M exists, for which the pressure at the centre of the sphere becomes infinite, and for which the velocity of light at the same point becomes zero. In the case of collapsed neutron stars M is of the order of a large stellar mass. It is expressed in terms of the charge and mass of the electron and the proton and the universal gravitational constant. The hypothesis is examined that supernova outbursts are caused by the formation of such neutron stars. The redshift in the spectrum of the supernova IC 4182 is interpreted as a gravitational redshift. The central star of a supernova one year after maximum brightness is of radius 100 km., average density 10^{12} gm./cm^3. and effective surface temperature greater than 5×10^6 deg. The light curves, spectra, and total generation of energy in supernovæ are discussed in the light of the neutron star hypothesis. A. Hu.

2419. Point-Source Model with Constant Opacity. P. C. Keenan. *Astrophys. J.* 89. *pp.* 499–508, *May*, 1939.—The differential equations for the point-source model, in the form derived by Chandrasekhar and von Neumann, have been integrated numerically for eight values $M\mu^2$ ranging from 19·3 to 31,500 in units of the sun's mass. All the solutions are characterised by negative density gradients in the central region, since ρ becomes zero at the centre. The radius at which the density is a maximum shifts outward with increasing mass so that ξ^*, the fraction of the radius containing 90% of the total mass, increases steadily from 0·65 to 0·98. For large masses the central regions are practically isothermal. The mass-luminosity curve becomes less steep with increasing mass, approaching the line $L \sim M$. The physical interest of the point-source model is increased by the agreement found between the model and the massive Trumpler stars, both in the values of ξ^* for corresponding masses and in position in the mass-luminosity diagram. AUTHOR.

2420. Determination of Distance of Galactic Centre. H. Shapley. *Nat. Acad. Sci., Proc.* 25. *pp.* 113–118, *March*, 1939.—Observations of the field of 80 square degrees centred at 18 h. 20 m., – 55° (1900), has revealed some 500 variable stars of which more than half are Cepheids, the limit of observation being about 17 m. Some 600 extra-galactic nebulæ have also been found in this region and consideration of their apparent magnitudes indicates a space-absorption correction of 0·61 m. This can be regarded as a zero-point correction to apparent magnitudes in this region, since the absorption appears to occur almost entirely in the solar neighbourhood. It then appears that there is a maximum in the number of variable stars at corrected apparent magnitude 14·7 and this is interpreted as being due to the fact that the line of sight passes near the galactic centre at the corresponding distance. The distance of the centre is calculated to be $9 \cdot 7 \pm 1 \cdot 2$ kpc. by this method. G. C. McV.

2421. Optical Thickness of the Galaxy. J. Dufay and D. Smoukovich. *Comptes Rendus*, 208. *pp.* 1204–1207, *April* 17, 1939.—Assuming the stars to be uniformly distributed between 2 infinite planes, parallel to the galactic plane, between which the coefficient of absorption is constant, an expression is obtained analytically for the brightness of the stellar origin, in first-magnitude stars per square degree, as a function of galactic latitude. The form of the expression can be reconciled with Seares's star-counts only by introducing a parameter whose physical significance is that the sun is in a region where either the coefficient of absorption is greater than in the rest of the galaxy, or the luminous intensity per unit volume is smaller. The values of the constants in the expression are hardly altered if instead of considering the whole sky, separate galactic longitudes are examined, account being taken of local deviations in the star distribution. This suggests that most of the absorption occurs in regions relatively close to the sun. A. Hu.

2422. Star Chains. E. Holmberg. *Zeits. f. Astrophysik*, 18. 2. *pp*. 132–140, 1939. *In English*.—The problem of star chains has been discussed by Oberguggenberger [see Abstract 595 (1939)]. A working definition of star chains was given, together with an account of the discovery of 338 chains on small scale plates covering the northern sky. From the distribution of the chains in longitude and from the distribution of their position angles it was supposed that the existence of the chains could not be explained from a purely statistical point of view. In the present paper it is shown that it is possible to explain the observed frequency of star chains as formed entirely by chance. Thus, the observed star chains should not in general be considered as physical systems, and their importance should be reduced to an interesting example of the application of the theory of probability. Reply by **V. Oberguggenberger** (*pp*. 140–141. *In German*). AUTHORS.

2423. Ursa Major Cluster. W. M. Smart. *Roy. Astron. Soc., M.N.* 99. *pp*. 441–450, *March*, 1939.—Of 34 stars suspected of being members of the Ursa Major cluster, it is concluded that 23 are cluster-stars. The position of the convergent point is found to be: R.A., 307°·5, Dec. –39°·3. The parallaxes and absolute magnitudes of the cluster-stars are calculated. The cluster-motion, referred to the mean of the stars near the sun, is found to be 29·5 km./sec., approximately in the galactic equator. Nearly half the stars lie within a sphere of radius 5 parsecs, and the remainder are roughly distributed along an axis towards the point (0°, 60°) in galactic coordinates. AUTHOR.

2424. Variable Stars in Globular Clusters. P. T. Oosterhoff. *Observatory*, 62. *pp*. 104–109, *April*, 1939.—The 5 clusters ω Cen, and M. 3, 5, 15, and 53 are considered for the *c*-type variables which have small amplitude and only slightly asymmetrical light curves, and for the *a*- and *b*-types, whose light curves are very asymmetrical, with a correlation between amplitude and period (short periods give larger amplitude). Tables and diagrams are given. M3 and M5 may differ slightly from other clusters. The 5 clusters are compared with the frequency distribution of the variables in a field in Corona Australis. It is suggested that the absolute median magnitude of the variables may be different from cluster to cluster. [See Abstract 1554 (1939).] A. S. D. M.

2425. Light Curve of δ Cephei. M. Schwarzschild. *Harvard Coll. Obs., Circ. No.* 431. [13 *pp*.], 1938.—The formula derived by the author in an earlier paper [see Abstract 4007 (1938) for the light variation of a Cepheid, assuming that the pulsation has the character of a progressive wave in the outer part of the interior, is compared with observation in the case of δ Cephei. The light curves of Stebbins and Danjon and the radial velocity curves of Jacobsen and Henroteau are combined and reduced to a common phase. The constants of the formula are then so determined that it is fulfilled as nearly as possible at every phase: this is done by deriving approximate values from a few selected phases, and then correcting these values by least squares, using 10 equidistant phases. The light curve thus computed from the velocity curve agrees well with the observed one except for a small phase shift at minimum which can be reasonably explained. Since the conclusions drawn from the derived values of the constants are physically reasonable, the " progressive wave " theory is held to be justified. A. Hu.

2426. Supernovæ and Stellar Collisions. F. L. Whipple. *Nat. Acad. Sci., Proc.* 25. *pp.* 118–124, *March,* 1939.—The possibility that supernovæ may be due to collisions between stars is examined. It is shown that the 20 supernovæ observed in external galaxies have occurred in the bright regions of the galaxies concerned. A theoretical calculation of the number of collisions to be expected in galaxies of total mass 2×10^{11} ⊙ gives a result comparable with the observed frequency of one supernova per galaxy per 600 years provided that the average star in a galaxy has 1/10 the sun's mass and 1/3 its radius. Energy considerations do not as yet give any sure indication as to the possibility of collision being the cause of supernovæ, even the observed amount of energy released in the phenomenon being uncertain. G. C. McV.

2427. Luminous Envelopes Around Novæ. P. Couderc. *Comptes Rendus,* 208. *pp.* 1275–1278, *April* 24, 1939.—The history of the nebulous luminosity which appeared around Nova Persei 1901 in its early stages is examined. Assuming that the effect is due to a pulse of light from the outburst illuminating a stationary envelope, the parallax is calculated to be 0″·011, whereas the true parallax, obtained from observations (1916–1935) of the expanding shell of ejected matter, is only 0″·0016. The author considers the implication that the phenomenon was travelling faster than light, and shows from the geometry of the case that the effect would appear to be propagated at a variable velocity, much greater at first than that of light. A study of the distribution of brightness in the N. Persei envelope suggests that the nebula concerned was composed of particles of diameters of the order of the wave-length of light. A. Hu.

2428. Third Fundamental Catalogue of the Berlin Astronomical Yearbook. Part II. Additional Stars for Epoch 1950. A. Kopff. *Preuss. Akad. Wiss. Berlin, Abhandlungen, No.* 3. [33 *pp.*], 1938.—The first part [*Veröff. Astr. Rechen-Inst.* No. 54. 1937] of the 3rd fundamental catalogue (FK3) of the Berlin Astronomical Yearbook comprised 925 stars selected by Auwers of which 52 have since been rejected as unsuitable. The present table gives the elements of 662 stars selected for addition to the remaining 873 Auwers-stars to complete FK3 for the 1950 epoch. J. E. K.

2429. Problems of Meridian Astronomy. H. Spencer Jones. *Roy. Astron. Soc., M.N.* 99. *pp.* 424–434, *Feb.*, 1939.—The purpose of meridian astronomy is to provide a fundamental system of reference, free as possible from systematic errors of any sort. The author gives a history of the methods used and their consequent errors, since 1674, in determining the equator and equinox positions, by eye and ear, by hand-tapping, the impersonal micrometer, by the substitution of minor planets (especially Vesta) for the sun or major planets; by the reversible transit instead of the fixed, and its errors with their correction; by the differences between different star catalogues; and the preparation of a fundamental system by continuing catalogues. He discusses the systems of Auwers, of FK3, and of Boss; and the determination of the constant of precession in relation to the fundamental reference system and the assumptions that are made about it. The future task will be to connect the positions of the external galaxies with the fundamental system. A. S. D. M.

2430. Physical State of Interstellar Hydrogen. B. Strömgren. *Astrophys. J.* 89. *pp.* 526–547, *May*, 1939.—The discovery, by Struve and Elvey, of extended areas in the Milky Way in which the Balmer lines are observed in emission suggests that hydrogen exists, in the ionised state, in large regions of space. The problem of the ionisation and excitation of hydrogen is first considered in a general way. An attempt is then made to arrive at a picture of the actual physical state of interstellar hydrogen. It is found that the Balmer-line emission should be limited to certain rather sharply bounded regions in space surrounding O-type stars or clusters of O-type stars. Such regions may have diameters of about 200 parsecs, which is in general agreement with the observations. Certain aspects of the problem of the ionisation of other elements and of the problem of the relative abundance of the elements in interstellar space are briefly discussed. The interstellar density of hydrogen is of the order of $N = 3\ \text{cm}^{-3}$. The extent of the emission regions at right angles to the galactic plane is discussed and is found to be very small. AUTHOR.

See also Abstracts 2395, 2399.

SUN.

2431. Hydrodynamical Experiments in Connection with Prominences. H. Zanstra. *Roy. Astron. Soc., M.N.* 99. *pp.* 499–523, *April*, 1939.—Experiments are discussed in which a flow of liquid spreading out into a basin from a hole in the bottom breaks up into a number of distinct outward currents or streamers. This streamer phenomenon is favoured by small viscosity per unit mass, and more highly viscous liquids tend to produce a purely radial flow. The streamer phenomenon is shown to be due to the fact that for a radial flow of radial symmetry the acceleration is inward and increases with the outward velocity. So, if in a certain sector the velocity is increased, it may be that the force present is unable to keep back sufficiently the liquid in its new state, and the outward motion increases still further. Thus a number of outward streamers result. This condition of instability is worked out quantitatively, and an approximate formula for the length of the currents derived. Experiments with various liquids are discussed, and there is approximate agreement with theory in all cases where the theoretical conditions are fulfilled. The considerations of instability are then applied to streamers in prominences, which occur when there is a general downward rush of gases. The conception of prominences of the streamer type as a collapsing ridge of gas is discussed, and it is shown that conditions are then favourable for the production of streamers. A water model suggests that the actual motion may take place in the form of a thin sheet dividing this ridge in half and possibly breaking up into streamers. Following up Gurney's earlier work [see Abstract 2093 (1928)] it is further shown that the luminosity in such prominences is very likely due to a mechanical excitation consisting of a non-reversible compression of the downward-going gases. This mechanism requires a concentration of the oncoming gases which is not excessive. In the downward rushing sheet, gases would both be strongly excited and strongly ionised by mechanical excitation. This offers an explanation for the extreme thinness of prominences seen in absorption in Hα or Ca^{+} spectroheliograms. It seems that streamers can be excited in three ways: by high kinetic temperature, by irreversible compression and by collisions with the surrounding gases. AUTHOR.

2432. Prominences and Sunspot Cycle. V. Barocas. *Astrophys. J.* 89. *pp.* 486–498, *May*, 1939.—The investigations by Lockyer, Evershed, and Bocchino on the relation between prominences and spots are extended to all the prominence observations from 1880 to 1937. A diagram is traced of all the six cycles under consideration, and the behaviour of high- and low-latitude prominences and their relationship to the sunspot cycle is examined. The so-called "metallic prominences" are present only in the low-latitude zone. AUTHOR.

2433. Relative Shifts of Line 5250·218 and Neighbouring Lines in Mt. Wilson Solar Magnetic Field Spectra. J. Evershed. *Roy. Astron. Soc., M.N.* 99. *pp.* 438–440, *March*, 1939.—Nine of the Mt. Wilson solar magnetic field spectra obtained in the year 1913 have been measured by the positive on negative method, and the relative shifts of four lines determined. Two of these are subject to large Zeeman effects in sunspots and laboratory, whilst the other two are much less affected. The results clearly show that in these spectra the shifts observed are not due to a general magnetic field, or to local magnetic fields, but are Doppler effects due to motion, notwithstanding certain indications to the contrary. AUTHOR.

See also Abstracts 2391, 2429, 2432.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

2434. Seismic Prospecting. E. A. Hodgson. *Roy. Astron. Soc. Canada, J.* 33. *pp.* 121–150, *April*, 1939.—The paper gives the procedure and field organisation adopted by a particular company operating in southern Alberta. W. A. R.

See also Abstract
1412B. Radiogeology in Mining. V. Fritsch.

HYDROSPHERE, PHYSICS OF THE.

***2435. Vessel for Obtaining Water Samples. E. Pellerin.** *Comptes Rendus*, 208. *pp.* 1039–1041, *March* 27, 1939.—An apparatus is described which is used to obtain samples of water from depths down to 250 m., which are sufficient for a study of the continental plateau. The sample tube has a capacity of about 2·5 l. and by a special device it is opened at the desired depth and closed again before raising. It is possible to determine the pressure at this depth by measuring the pressure inside the tube. R. S. R.

LAND, PHYSICS OF THE.

2436. Density of Earth's Interior. H. Fabre. *Bull. Astronomique*, 11. 5–6. *pp.* 313–326, 1938.—Historical review of research on the variation of density in the interior of the earth. W. A. R.

2437. Volcanism and Nuclear Chemistry. J. Noetzlin. *Comptes Rendus*, 208. *pp.* 1100–1102, *April* 3, 1939.—It is suggested that as rupture of the U nucleus by neutron impact may under certain circumstances be a chain reaction, giving rise to increasing production of neutrons and consequently to progressively increasing production of heat, it may explain volcanic phenomena. C. A. S.

2438. Elastic and Viscous Properties of Pumice. K. Iida. *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 59–77, *March*, 1939. *In English.*—The rock examined was pumice from Niizima. It was cut into cylinders 48 cm. × 5 cm. (dia.) and 10 × 1·7 cm.; density of crushed rock 2·314. Determinations were made of the various constants [for symbols see Abstract 4030 (1938)] both dynamically and statically for 15 samples containing different percentages of water (0–24·9%) and the results plotted against H_2O content. For dry pumice the results are: (dynamically determined) $E\ 8\cdot89 \times 10^9$, $\mu\ 3\cdot76 \times 10^9$, $\sigma\ 0\cdot18$, $\gamma l\ 4\cdot962 \times 10^{-6}$, $\gamma_t\ 1\cdot041 \times 10^{-6}$, $\lambda/\mu\ 0\cdot564$, $\lambda'/\mu'\ 6\cdot43$; (statically determined) $E\ 5\cdot499 \times 10^9$, $\mu\ 2\cdot392 \times 10^9$, $\sigma\ 0\cdot15$, $\eta\ 1\cdot60 \times 10^{14}$. C. A. S.

***2439. Young's Modulus and Solid Viscosity of Rocks Determined by Vibration Method. K. Iida.** *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 79–91, *March*, 1939. *In English.*—The apparatus used, which generally resembles that previously described [see Abstract 4468 (1935)] is described in detail. Determinations of Young's modulus, E, and solid viscosity coefficient, γ, for brass, Al and steel agreed reasonably well with other determinations, but showed small increases with increased relative length of the cylinders of metal used. The method was then applied to similarly shaped samples of rock giving as results for marble (d 2·725), granite (d 2·610), sandstone (d 1·921), and pumice (d 0·630): for E 7·21, 2·89, ·0999, and $0\cdot0813 \times 10^{11}$: and for γ 7·18, 3·13, 2·02 and $4\cdot12 \times 10^6$ respectively. C. A. S.

2440. Flow of Air and Natural Gas through Porous Media. T. W. Johnson and D. B. Taliaferro. *Bureau of Mines, Techn. Paper No.* 592. [55 *pp.*], 1938.—The experimental details and results of a large number of tests on the flow of air and natural gas through consolidated porous media are given. The flow through porous media differs from flow in pipe lines in that the transition from straight line to turbulent flow extends over a wide range of flow rates. This may be explained by analogy with flow through a great number of conduits of different sizes. A general equation for the flow of gas through consolidated and unconsolidated sands is given. Porosity alone is not a measure of permeability although other factors being constant, the permeability increases with porosity. Grain size is an important factor in permeability and the shape also influences the flow, round grains allowing greater flow than angular. J. B. W.

METEOROLOGY.

2441. High Latitude Ozone Measurements. R. A. Hamilton. *Roy. Meteorolog. Soc., J.* 65. *pp.* 210–214; *Disc.*, 214, *April*, 1939.—Observations were made at North-East Land to determine the amount of O_3 in the upper atmosphere by measuring the u.v. absorption in the spectrum of the Pole star. A quartz spectrograph was used and the spectra were examined by a photometer. The densities of the spectra for wavelength 3290 and 3092 Å were compared with the equal densities on an image on the plate of a source of light whose intensity varied along the image according to a known law. The constants were determined by carrying out a similar experiment at Oxford at night when the amount of O_3 on the previous and following days had been measured by the standard method. Trouble was caused by the fogging of the plates caused by auroral light, but this was corrected for by a statistical method. The mean error of each determination was of the order of 30×10^{-3} cm., but the day-to-day fluctuation was found to be far greater than this and than the fluctuation observed in lower latitudes. There was no apparent connection between the amount of auroræ and the amount of O_3. The results show that the autumn fall in the amount of O_3 observed at all latitudes is continued through the winter and is followed by a sudden rise in spring. AUTHOR.

2442. Daily Variation of Atmospheric O_3 near the Ground. R. Auer. *Gerlands Beitr. z. Geophys.* 54. 2. *pp.* 137–145, 1939.—The observations discussed were carried out between Sept. and Dec. 1938 near Friedrichshafen. The O_3 content was determined by means of the Regener KI method, a description of the process being given. A series of diagrams shows the variation of O_3 content during the day under different conditions of pressure cloud and wind. The results are then summarised. The author points out, however, that his conclusions refer only to a limited area and to a particular time of year. To deal with the whole problem of O_3 variation, further investigation is necessary. A. E. M. G.

2443. Night Temperature of the High Atmosphere. D. Barbier and D. Chalonge. *Comptes Rendus*, 208. *pp.* 1238–1240, *April* 17, 1939. —As the temperatures arrived at in a previous investigation [see Abstract 1994 (1939)] appeared to be very low a new set of observations was made in Sept. 1938 on the Jungfraujoch. The same method of investigation was followed as before. With the notation defined in the previous article, the mean temperature of the O_3 is given by $(20 - T)/100 = \Sigma y/\Sigma x$, where the summation extends to all the bands observed in the atmosphere. According to the values of the series of coefficients used, different temperature values are found. All, however, are low compared with those found in the daytime. At present the authors are unable to say whether this is a real difference or is due to some systematic error, but consider that observations made in the daytime at the same period as the above and now being examined will decide the point. A. E. M. G.

2444. Radio Sounding in the Stratosphere of Southern Latitudes. R. Bureau, M. Douguet and P. Wehrlé. *Comptes Rendus*, 208. *pp.* 1419–1420, *May* 1, 1939.—The altitude of the base of the stratosphere has been determined by radio methods. A study of the variations of this altitude with temperature in the latitude of Paris and in southern latitudes, over the sea, throws light on the movements of Arctic and tropical air masses. In the latitude of Kerguélen where the temperature at the base of the stratosphere ranges from − 55 to − 37° C. the height is generally less than 10 km. A. B. W.

2445. Temperature Changes Produced by Radiation in the Upper Troposhere over Anticyclonic Regions. F. Kortüm. *Gerlands Beitr. z. Geophys.* 54. 2. *pp.* 148–167, 1939.—The general relations of subtropical and polar air masses in the upper troposphere and the advection of these air masses to other latitudes are considered. Four series of ascents are investigated. It is considered that the thermal conditions of these air masses and their advection to other latitudes can be explained by an adjustment to the conditions of their new surroundings by radiative processes. This involves for subtropical air masses an increase and for polar air masses a decrease of radiative cooling. The assimilation takes place in such a way that important gains occur for the heat content of an anticyclone. For the upper troposphere as a whole in both cases the time for the half value is about six days. R. S. R.

2446. Fluctuations of U.V. Solar Radiation. G. R. Miczaika. *Zeits. f. Astrophysik,* 18. 2. *pp.* 151–154, 1939.—The author shows that the annual fluctuations of u.v. solar radiation are not sufficient to explain the observed fluctuations of intensity. The hypothesis is put forward that changes of the pressure and humidity of the air are responsible for the differences in the intensity. L. K.

2447. Variations of Solar Constant and their Relation to Weather. C. G. Abbot. *Roy. Meteorolog. Soc., J.* 65. *pp.* 215–236, *April,* 1939.—This paper is a reply to criticisms made by Paranjpe [see Abstract 3607 (1938)] and Brunt on the determination of the solar constant and the work based on the supposed variability of the constant. The author first deals with solar variation as a major weather cause, showing that day-to-day solar changes profoundly influence temperature. This effect is illustrated graphically. Next it is pointed out that the correlation of day-to-day solar constant values from different observations is incompetent to refute the sun's important variability, the various points raised in this connection being considered separately. A detailed explanation of the discovery of 12 long periods in solar variation is given, the periodicities are tabulated, synthesised, and the synthesised curve compared with observed monthly mean values. Very good agreement is found. In conclusion the author emphasises the point that as solar variation is the principal cause of weather changes, it should be possible, given sufficient observations, to predict principal details of weather two weeks in advance. [See also *Nature,* 143. *pp.* 705–709, *April* 29, 1939.] A. E. M. G.

***2448. Integrating Altimeter for Aerial Sounding. J. Lugeon.** *Comptes Rendus,* 208. *pp.* 1327–1329, *April* 24, 1939.—In a previous paper [see Abstract 1997 (1939)], use was made of a diagram in estimating the height values in a sounding. The present note describes two pieces of apparatus which enable the diagram to be dispensed with. The first consists essentially of a disc on which the angles indicate pressure in millibars. To the centre of the disc is attached an arm which can turn freely. This arm is graduated in temperature degrees. A description of the use of this apparatus along with an ordinary Amsler planimeter is given. As the Amsler planimeter would require in some cases a rather cumbrous diagram the author has devised another type of planimeter. This is fully described and is illustrated by a line diagram. In this way it is now possible to have an altimeter registering entirely automatically the altitude of a radio sounding during the flight. A. E. M. G.

***2449. Reliability of Dust-Counters. F. Běhounek.** *Terr. Mag.* 44. *pp.* 21–22, *March,* 1939.—Three types of counter are considered (1) the automatic dust-recorder, (2) the jet dust-counter, both devised by Owens, and (3) the Zeiss Konimeter. The methods employed in arriving at results in the case of each type are indicated. When the numbers obtained for dust content with the same instrument by different observers are examined it is found that the results under similar conditions differ considerably. To illustrate this, particular cases are considered. The author suggests that the discrepancies indicate experimental reasons controlling the action of dust counters, and considers there are at least three important factors contributing to this (1) the velocity of air flow, (2) the magnification of the microscope, (3) the method of fixation of the particles. These are commented on in turn. A. E. M. G.

2450. Air Pollution in Dublin during 1938. A. G. G. Leonard and B. P. McVerry. *Roy. Dublin Soc., Proc.* 22. *pp.* 83–93, *April,* 1939.—Observations were carried out from Jan. 6 to Dec. 31, 1938, and the amounts of the various impurities both soluble and insoluble are given in tabular form for each month. Comparison is made with the results in 1936–37 for other towns. Suspended impurity was also examined with an Owens filter, and the normal trend of the daily graph gives a minimum about 4 a.m., rising to a maximum between 9 and 10 a.m. The differences in content between summer and winter, Sundays and week-days, are next investigated and shown graphically. The authors thereafter examine the effect of wind velocity and direction on the suspended matter and the results are set out in tabular form, and discussed. A. E. M. G.

2451. Artificial Dissipation of Fog. D. Brunt. *Journ. Sci. Instruments,* 16. *pp.* 137–140, *May,* 1939.—The processes involved in the formation of fog by radiation to a clear sky or by warm damp air flowing over a cold surface are first explained, and the amount of liquid water in each and the rate of flow estimated. Chemical and heating methods for fog dissipation are treated. Calculations of the amount of saturated $CaCl_2$ solution, and the size and cost of the equipment and its deterioration by corrosion show the former method to be impracticable. For the latter the rate of consumption of oil or domestic gas to produce the necessary rise of temperature through the fog is obtained but it is essential for a wind to be blowing if success is to result. R. S. R.

2452. What Happens to the Rain? B. A. Keen. *Roy. Meteorolog. Soc., J.* 65. *pp.* 123–137, *April,* 1939.—An annual rainfall of 30 in. means that 3000 tons of water fall on an acre of land. In the course of the year this all disappears, by run-off, evaporation, transpiration through vegetation, and by downward percolation. The relative importance of these factors in British and overseas conditions is discussed. Many of the traditional beliefs among farmers and gardeners were based on a theory of water movement that was attractively simple to understand—but incorrect. It is only in recent years that the true picture of the movement of water in the soil has been built up. In consequence, some of the traditional practices need revision, while others now have a different explanation. The new work has also clarified some of the concepts used in hydrology. AUTHOR.

2453. Local Climate and Growth of Trees with Special Reference to Frost. W. R. Day. *Roy. Meteorolog. Soc., J.* 65. *pp.* 195–207; *Disc.,* 207–209, *April,* 1939.—The type of forest is largely determined by the general climate, but local climatic conditions exercise considerable influence. The natural forest in the British Isles is composed of species, some of which are relatively hardy to frost, whereas others are, in comparison, easily injured by it. The latter species usually form the final woodland, and their successful growth is made possible by the development of favourable conditions of climate and soil within woodland formed first of all by hardy species. Examples are given to illustrate the effect of overhead and side shelter on the temperature of the air over the ground. The influence of topography on frost is also illustrated and discussed. The effect of accessory factors, such as soil fertility, local warm or cold situations, and the general suitability of the exotic species to the climate to which they are introduced are also shortly discussed in relation to the occurrence of frost injury. AUTHOR.

*__2454. Night-Visibility Meter. E. Gold.__ *Roy. Meteorolog. Soc., J.* 65. *pp.* 139–159 ; *Disc.*, 159–164, *April*, 1939.—The paper contains an account of a method of ascertaining the visibility number V of the International Scale of Visibility from observations of lights at fixed distances smaller than the actual distance of visibility. The method depends on the use of a meter with a filter in which the obscuring power varies continuously from zero to a value large enough to obscure the selected lights when the atmosphere is clear. The construction of the meter and its method of use are described. A unit of obscuring power is defined such that 100 units reduce the intensity of light to 1/1000th part of its incident value. The unit is of a convenient practical size for use in the graduation of the meter. In view of its utility the name " nebule " is proposed for this unit. The paper also contains an account of a method of estimating the distance of " sure " visibility of lights of different candle power at different distances in conditions of atmospheric turbidity corresponding with the different numbers of the standard scale of visibility, and suggestions for the construction of a more logical scale of visibility than the existing International Scale. AUTHOR.

2455. Measurement of Intensity of Light of Night Sky by Cæsium Photo-Cell. R. Grandmontagne. *Comptes Rendus*, 208. *pp.* 1135–1137, *April* 12, 1939.—The intensity of the light of the night sky is compared with that of an artificial source consisting of an incandescent filament giving light of constant intensity. This source is in turn calibrated with that of a tungsten filament lamp of colour-temperature 2100° K. The intensity of the light of the night sky can thus be found in terms of that of the standard candle and gives $12 \cdot 4 \times 10^{-8}$ candle per cm^2. This value, being the intensity measured in red light, turns out to be ten times that found from comparisons with the Pole star which give the intensity in blue. G. C. McV.

2456. New Description of Night-Sky U.V. Spectrum. A. Arnulf, R. Bernard, D. Cavassilas and G. Déjardin. *Comptes Rendus*, 208. *pp.* 1329–1331, *April* 24, 1939.—A table gives the results of the examination with a Chalonge microphotometer of five spectrograms of the night sky. These are in good agreement with the results of previous observations. This has led the authors to consider afresh the origin of the radiations. Their conclusions are summarised. While they are able to suggest the probable origin for most of the lines they find it impossible to pronounce definitely on the origin of the four most intense and most characteristic lines. A. E. M. G.

2457. Change of Height of Aurora on Passing from Dark to Sunlit Atmosphere. L. Harang. *Gerlands Beitr. z. Geophys.* 54. 2. *pp.* 81–93, 1939.—Aurora lying in the border between the dark and the sunlit atmosphere show an increase of heights when going from the dark to the sunlit atmosphere. The increase of the heights is explained as due to thermal expansion of the sunlit atmosphere. Parallactic photographs from three evenings are discussed and the temperature increase is computed. If the temperature of the atmosphere at 100 km. height be 225° K., a temperature of 260–300° K. of the sunlit atmosphere with 50 km. height of the earth's shadow is computed. AUTHOR.

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2458. Blue Auroral Rays in Sunlit Part of Atmosphere. C. Störmer. *Terr. Mag.* 44. *pp.* 7–14, *March,* 1939.—Only two instances of blue rays have been observed by the author since 1911, the first on March 23, 1920, the second on Sept. 15, 1938, both before sunrise. The second instance is discussed in the present paper. The heights of various points were measured and the results are given. Several spectra were photographed and certain of these have been examined. One set is reproduced showing corresponding spectra in the blue sunlit rays and in the yellow green curtains. Lines in the blue and violet of the sunlit set are seen to be of unusual intensity. The relative intensities of corresponding lines are also set out in tabular form. In conclusion the author remarks upon the many other auroral forms which have occurred during recent years. A. E. M. G.

2459. Aurora of Feb. 24–25, 1939, in Arosa. F. W. P. Götz and R. Penndorf. *Naturwiss.* 27. *pp.* 241–243, *April* 14, 1939.—A new phenomenon was observed at Tschuggen (2040 m.) and a description of the colouring and elevation of the draperies and rays together with two photographs, are given. Two systems apparently were present. During the night the auroral phenomena moved eastwards. Similar phases in magnetic activity were observed at Leipzig and, to a smaller extent, at Regensburg, Switzerland, indicating a magnetic storm. Land line telegraphy to Germany was impossible. R. S. R.

2460. Possible Presence of CN Bands in Spectrum of Red Aurora of Type B. R. Bernard. *Comptes Rendus,* 208. *pp.* 1165–1167, *May* 12, 1939.—In a recent paper [see Abstract 2000 (1939)] the author considers that the colour in the red auroræ of type B may be due to the presence of bands sufficiently like those of the green auroræ to be considered as having the same origin. This is further examined. As red bands of CN have been observed in the spectrum of the night sky, it is thought that they may be present in the auroral spectrum also. This idea is tested by observing a spectrum of N containing traces of C compounds. A table gives wave-lengths of radiations observed in the auroral spectrum and in that of the discharge tube. From this it is concluded that CN bands appear to be present in the auroral spectrum and particularly in the red auroræ of type B. A. E. M. G.

See also Abstracts 2393, 2469, 2654 and
1374B. Direct Reading Humidity Meter.

SEISMOLOGY.

2461. Seismic Waves. Part IV. B. Gutenberg and C. F. Richter. *Gerlands Beitr. z. Geophys.* 54. 2. *pp.* 94–136, 1939. *In English.*—Travel times and velocities of seismic waves have been revised, using observational data from deep-focus earthquakes. Travel times for zero focal depth are given for all important phases. The revised velocity distribution closely represents the observations of PcP, PcS, and ScS, as well as the arrival times of waves at the epicentre and anticentre. The revision includes a reinterpretation of the observations of P′ and SKS. Velocities and elastic constants are tabulated as functions of depth. [For Part III see Abstract 3570 (1936).] AUTHORS.

2462. Seismic Faults. M. Ishimoto. *Imp. Acad. Tokyo, Proc.* 15. *pp.* 36–38, *Feb.,* 1939. *In French.*—Faults connected with earthquakes show certain characters. Movement is greatest in the centre of the faultline and diminishes outwards, and seems to indicate that both vertical contraction and expansion take place. Such peculiarities can only be produced by pressure exerted from below, and the author is of opinion that this pressure arises through expansion caused by solidification of a magmatic body underlying the seat of the quake. W. A. R.

2463. Range of Possible Existence of Stoneley Waves. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 1–8, *March,* 1939. *In English.*—Stoneley found [see Abstract 273 (1925)] that Rayleigh-type waves may be transmitted along the surface of separation of two solids. The paper determines the conditions under which such waves can exist. W. A. R.

2464. Damping of Periodic Visco-Elastic Waves with Increase in Focal Distance. Part II. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 9–26, *March,* 1939. *In English.*—Continuing previous work [see Abstract 4875 (1938)] several cases of attenuation of visco-elastic waves with increase in focal distance are demonstrated; namely, two-dimensional transmission of Rayleigh and Love waves, transmission of similar waves on a spherical surface, and transmission of Love waves through a heterogeneous body. In the case of Rayleigh waves in a visco-elastic body the coefficient of damping of the waves is intermediate between those of distortional and dilatational waves in the same body. The same condition applies to the damping coefficient of Rayleigh waves with time increase. The coefficients of damping for Love waves under the conditions investigated do not differ much from those for transverse waves. W. A. R.

2465. Analysis of Seismic Waves. P. Caloi. *Ricerca Scientifica,* 10. *pp.* 275–290, *April,* 1939.—A chosen seismogram was subjected to harmonic analysis. All five components detected in the *S*-phase had the same velocity of propagation, the maxima corresponding to that of the resultant wave; in other words diversity of period among the constituent waves does not imply diversity in their velocities. Analysis of the *SS* wave supports the hypothesis that only a limited number of the *S*-constituents are reflected at the surface. Under continental masses the velocity of propagation of long waves varies almost linearly with the period; under the oceans the velocity of propagation of these waves is greater than under continents. W. A. R.

2466. Model Experiments for Confirming the Dissipation Phenomena (Scattering) in the Seismic Vibration of a Structure. K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 37–48, *March,* 1939. *In English.*—The dissipation of vibrational energy into the ground was confirmed by means of model experiments using gelatin models. Although the viscous damping in the model was too high to show the dissipation phenomena quantitatively it was possible to confirm the dissipation qualitatively. The experimental results were checked by mathematical calculations. It was also ascertained that the viscosity in the structure itself and the dissipation are effective on the vibration damping in the same sense. R. S. R.

2467. Forced Vibrations of a Structure. K. Iida. *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 49–57, *March,* 1939. *In English.*—The forced shearing vibration of a structure was mathematically investigated, especially the relations between the elements such as the damping factor, height, and modulus of rigidity of a structure, while the stress at its foot was obtained. It was ascertained that the greater the damping term, the modulus of rigidity, and the height of the structure under the short period of the forced vibration, the smaller the stress at the foot. The dynamical treatment shows that if suitable deformation were allowed for in a structure much of the stress could be avoided. To minimise earthquake damage the important points to be recollected are the relations between the period of vibration of the earthquake, and the height, elasticity and pliability of the structure. It is hoped to continue the investigation with the aid of models. R. S. R.

***2468. Mechanical Microseismograph for Vertical Component. M. Ishimoto, K. Iida and Z. Kinosita.** *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 144–150, *March,* 1939. *In French.*—The instrument is figured diagrammatically and as actually made. The horizontal pendulum weights 30 kg. and is supported by a vertical spiral spring and 2 steel plates. The period of vibration is about 0·51 sec., and the geometrical magnification about 570, which can be multiplied by 5–10 photographically. Examples of seismograms obtained with it are given. [See Abstract 3575 (1936).] C. A. S.

See also Abstract 2588.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2469. Condensation-Nuclei in Atmosphere in Peru, and their Relation to Atmospheric-Electrical and Meteorological Observations. O. W. Torreson. *Terr. Mag.* 44. *pp.* 59–74, *March,* 1939.—The observations examined here were carried out during the period June, 1934, to Dec., 1936, inclusive. The observatory (Long. 75 W., Lat. 12 S.) is situated at 3350 m. above mean sea-level. Condensation-nuclei, potential gradient, and conductivity were observed daily and rainfall records kept. The monthly mean values are tabulated and corresponding curves drawn. These indicate that in the dry season nuclei are twice as numerous as in the wet season, that conductivity becomes distinctly higher when nuclei are few, while potential gradient increases with increase of nuclei content. Detailed study of daily observations in the three dry months of June support these conclusions. The investigation also deals with the size of the nuclei, the combining coefficients for charged and uncharged nuclei with small ions and the variation of these coefficients with ion concentration. Numerical values are given for these various quantities. A. E. M. G.

2470. Diurnal Variation of Atmospheric Electrical Conductivity and of Number of Ions and Condensation-Nuclei at Chambon-la-Forêt. O. Thellier. *Comptes Rendus,* 208. *pp.* 1167–1170, *April* 12, 1939.—Several series of observations made from May to Nov., 1938, and in Feb., 1939, by means of apparatus already described [see Abstract 2489 (1935)] are analysed and discussed. Three periods are considered (1) summer, June to Sept. inclusive; (2) Feb., and (3) Oct. Tables give the mean values of conductivity, etc., at 4 hr. intervals during the day, for the first two periods. These tables show that the variations in these quantities throughout the day are different in summer and in Feb. The Oct. period shows a transition stage. The fact that abrupt changes do not manifest themselves in some of the quantities is attributed to the remote position of the observatory. A. E. M. G.

2471. Theories of Electric Fields below Clouds. J. A. Chalmers. *Roy. Meteorolog. Soc., J.* 65. *pp.* 237–243, *April,* 1939.—Attention is drawn to the discrepancy between the electric fields actually existing below thunderclouds, as measured by the alti-electrograph, and those expected on a theory due to Wilson. An attempt to remove the discrepancy by the consideration of the presence of negative ions as well as the positive ions produced by point discharge decreases, but does not remove it, and there remains an unsolved problem. AUTHOR.

***2472. Recording Generating Voltmeter for Study of Atmospheric Electricity. E. J. Workman and R. E. Holzer.** *Rev. Sci. Instruments,* 10. *pp.* 160–163, *May,* 1939.—A generating voltmeter-type automatic electric field recorder designed for continuous measurement of surface electric fields in thunderstorms is described. The performance of the instrument in the field under thunderstorm conditions is discussed. The application of this instrument to the study of the normal potential gradient of the earth is suggested. AUTHORS.

2473. Variations in the Disturbance Field of Magnetic Storms. B. Cynk. *Terr. Mag.* 44. *pp.* 51–57, *March,* 1939.—Chapman's investigation has been extended by using more stations and data. Between the N and S auroral zones 14 stations in various latitudes were used. Chapman's conclusion that the form of the disturbance field due to the storm-time disturbance field (D_m) was generally independent of the intensity of the magnetic disturbance over considerable ranges of activity, was confirmed. It was found that (1) the storm field was stronger at practically all latitudes during the equinoctial months March, April, Sept. and Oct., than at others, (2) the H component of D_m was nearly twice as great in the local winter as in the local summer season, and (3) the averages for the year and equinoxes of the geographical distribution of the H component of D_m are approximately symmetrical about the geomagnetic equator. Thus the D_m field has a part symmetrical about the equator together with a sinusoidal part. The average characteristics of the sinusoidal part are examined. R. S. R.

See also Abstracts 2459, 2495.

RADIOACTIVITY.

2474. Production of Photo-Neutrons by a Ra-Be Source. Z. Ollano. *N. Cimento,* 15. *pp.* 541–550, *Nov.,* 1938.—The number of neutrons emitted by a Ra-Be source is determined by a method developed by Amaldi and Fermi [see Abstract 17 (1937)] in which the density of neutrons of thermal velocity is measured at different points with a Rh-detector and calibrated Geiger-Müller counter when the source is surrounded with water. The average cross-section for the nuclear photo-effect of the harder γ-rays of RaC″ in Be is found as $(2\cdot 0 \pm 0\cdot 3)\cdot 10^{-27}$ cm^2., in good agreement with measurements of Dementi and Frisch and their co-workers (see *Nature,* 140. *p.* 895, 1937, and *Phys. Zeits. d. Sowjetunion,* 12. *p.* 764, 1937). L. E. F.

2475. Artificial Radioactivity. Part IV. K. Diebner and E. Grassmann. *Phys. Zeits.* 40. *pp.* 297–314, *April* 15, 1939.—Continuation of review [see Abstract 3192 (1938)] of the radioactive properties of the artificially produced radioactive elements. The report is divided into 5 sections dealing with the production of artificial radioactivity by α-

particles, protons, deuterons, neutrons and γ-radiation. Together with the previous work, the number of cited references now reaches 452.

F. C. C.

2476. Dissymmetry of Rupture of U. G. Beck and P. Havas. *Comptes Rendus*, 208. *pp.* 1084–1086, *April* 3, 1939.—The probabilities of various forms of rupture of the U nucleus by impact of a neutron are calculated, and that resulting in production of atoms of numbers 37 and 55 shown to be greatest, and distinctly greater than for formation of two nuclei of more equal weight. C. A. S.

2477. Neutrons Emitted during Splitting of U by Neutrons. C. Magnan. *Comptes Rendus*, 208. *pp.* 1218–1220, *April* 17, 1939.—With an ionisation chamber lined internally with U_3O_8, inside which is 1·5 cm. of paraffin, the whole being coated externally with 6 cm. paraffin, outside which is placed a source of neutrons (Li + Be), ionisation corresponding with arrival of some 170,000 pairs of ions per min. was observed. The effect was increased by 40% on trebling the thickness of the U_3O_8. Various explanations are suggested, one being that ruptures of the U nucleus proceed as a chain reaction, each chain limited to about 50 ruptures; another that showers of about 50 protons are formed. C. A. S.

2478. Groups of Protons Emitted on Bombarding Hydrogenous Substances with α-Particles. Tsien San-Tsiang. *Comptes Rendus*, 208. *pp.* 1302–1303, *April* 24, 1939.—Experiments are described showing that the protons emitted on bombarding H-containing material with α-particles from Po fall into six groups of different free paths, four of which are practically identical with similar groups found by Riedl [see Abstract 4893 (1938)]. These groups correspond with groups of the bombarding α-particles. C. A. S.

2479. Disintegration of B by Protons. K. Fink. *Ann. d. Physik*, 34. 8. *pp.* 717–739, *April*, 1939.—An apparatus is described in some detail consisting of two point counters, with which coincidence measurements have been carried out on certain nuclear transformations. The apparatus was calibrated by measurements on the process $Li^7(p, \alpha)\alpha$. Experiments using the processes $B^{11}(p, \alpha)Be^8$ and $B^{11}(p, \alpha)\alpha\alpha$ are described. From the former it is concluded that the Be^8 nucleus is unstable, undergoing spontaneous disintegration into two α-particles [see Abstract 4450 (1938)]. Absorption measurements do not support the hypothesis that the disintegration is isotropic with respect to a coordinate system moving with the C.G. of the Be^8 nucleus. Similar difficulties arise in the quantitative explanation of the B^{11} $(p,\alpha)\alpha\alpha$ process, and the number of observed coincidences is considerably smaller for all ranges of the α-particles than that predicted by Dee and Gilbert [see Abstract 1401 (1936)].

E. E. W.

2480. Distribution of Disintegration Particles Formed from Nitrogen by Rapid Neutrons. Resonance Levels of ^{15}N. J. Thibaud and P. Comparat. *J. de Physique et le Radium*, 10. *pp.* 161–170, *April*, 1939.—A connected and amplified account of results previously published and of the methods by which they were obtained [see Abstract 204 (1939)]. The finally adopted energies $(E_{\alpha+B})$, of the 14 groups of particles of energies $\ngtr 3 \cdot 3 \times 10^6$ resulting from disintegration of ^{14}N by rapid neutrons from Ra + Be are 3·30, 3·05, 2·75, 2·55, 2·25, 2·05, 1·75, 1·60, 1·40, 1·25, 1·05, 0·90, 0·75, and 0·60 × 10^6 eV. They correspond with nuclear levels of the intermediate nucleus ^{15}N, lying between 11 and 14 × 10^6 eV. Reasons are given for considering the groups of energies $> 1\cdot4 \times 10^6$ eV to result from the reaction ${}^{14}_{7}\mathrm{N} + {}^{1}_{0}n \rightarrow {}^{11}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He}$, those with energies less than that amount from ${}^{14}_{7}\mathrm{N} + {}^{1}_{0}n \rightarrow {}^{14}_{6}\mathrm{C} + {}^{1}_{1}\mathrm{H}$, but that all arise from resonance levels of the intermediate nucleus ${}^{15}_{7}\mathrm{N}$. C. A. S.

***2481. Nuclear Isomerism in Element 43. G. T. Seaborg and E. Segrè.** *Phys. Rev.* 55. *pp.* 808–814, *May* 1, 1939.—A case of nuclear isomerism in element 43 has been thoroughly studied and is described. An activity of 6·6 hours half-life, which grows from a 67-hour Mo activity and has been chemically identified as element 43, decays with the emission of a line spectrum of electrons and no observable nuclear β-particles. Absorption measurements in Al and measurements with a magnetic spectrograph give an energy for the electrons of 116 ekV. This line spectrum must be due to the conversion electrons of a highly converted γ-ray of energy 136 ekV and arises as the result of a transition from an excited state of this isotope of element 43. The ground state is either stable or very long-lived. X-rays are also observed, and critical absorption measurements, as well as observations with a bent crystal spectrograph, show that they are to be ascribed to the Kα line of element 43, as is to be expected from this interpretation. The 6·6-hour activity also emits γ-rays of about 180 ekV energy; the measurements show that these are to be interpreted as following the transition which gives rise to the conversion electrons. A description of the chemical identification of the 6·6-hour activity is given. Other activities of element 43 are mentioned. In an Appendix (*ibid. p.* 814) **W. Gentner and E. Segrè** describe the calibration of the ionisation chamber. AUTHORS.

2482. Neutrons from Breakup of He^5. H. Staub and W. E. Stephens. *Phys. Rev.* 55. *pp.* 845–850, *May* 1, 1939.—The energy spectrum of the neutrons from the disintegration of Li by 0·8-eMV deuterons has been measured by the method of recoil particles in a high pressure cloud chamber at different stopping powers. A sharp drop in the number-energy curve at 3·8 eMV is interpreted as indicating the maximum energy of the neutrons from the two-stage reaction: $\mathrm{Li}^7 + \mathrm{D}^2 \rightarrow \mathrm{He}^4 + \mathrm{He}^5 + 14\cdot3$ emV . . . (1); and $\mathrm{He}^5 \rightarrow \mathrm{He}^4 + n^1 + 0\cdot8$ emV . . . . (1·0). By measuring the α-particle spectrum with an ionisation-chamber linear-amplifier counter, the relative number of α-particles from (1) gave the relative probability of reaction (1) and hence (1·0) in good agreement with the observed relative number of neutrons. AUTHORS.

2483. Scattering of α-Particles by A, O$_2$ and Ne. G. Brubaker. *Phys. Rev.* 55. *p.* 877, *May* 1, 1939.—Corrections to the original paper [see Abstract 646 (1939)].

***2484. Recent Developments in Cyclotron Technique. W. B. Mann.** *Nature*, 143. *pp.* 583–585, *April* 8, 1939.—Various developments in cyclotron technique are discussed. At Berkeley, use of the full ion current within the dees (instead of only the 10% which is usually withdrawn by deflection) results in the preparation by Wilson and Kamen of several mc./mg. of P per day. The collimation of fast neutrons for clinical purposes, by means of an air channel through a water tank is being developed by Aebersold and Anslow. To eliminate γ-radiation the channel and the outside of the water tank are surrounded with lead. The production of monokinetic beams of neutrons by modulation of the cyclotron beam is being carried out satisfactorily by Alvarez although the resolution is not as sharp as may be obtained with a discharge tube. The possibility of compensating for the defocusing caused by the relativity effect at high energies has been examined by L. H. Thomas who suggests that the magnetic field of the cyclotron should vary periodically along the path of the ion as well as along the radius to the path. There are now about 26 cyclotrons either operating or under construction in different parts of the world. F. C. C.

2485. Phenomenon Observed with Rutherford-Geiger Tube-Counter Submitted to Strong Irradiation. B. Kwal. *Comptes Rendus*, 208. *pp.* 1082–1084, *April* 3, 1939.—If in front of the window (of Al, 0·001 mm. thick) of a Rutherford-Geiger tube-counter (the tube filled with A at 180 mm.) a Po source is placed and the emitted α-particles filtered off by Al, only the protons are detected. If the potential is increased the counter becomes sensitive to electrons, and the γ-rays from Po may be counted. If, however, the source is placed directly against the window the thyratron circuit ceases to count unless the potential is diminished to a certain degree, when counting begins again, but the counting diminishes again on further reduction of the potential. Introduction of greater thicknesses of Al increases the potential at which the change begins. Possible explanations are discussed. C. A. S.

See also Abstracts 2268, 2284, 2358, 2365, 2437, 2585, 2625.

RADIATION.

ABSORPTION.

See Abstract 2304.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2486. Influence of Molecular Interaction on Magnetic Birefringence of Polar Liquids. A. Piekara. *Comptes Rendus*, 208. *pp.* 990–992, *March* 27, 1939.—The variation with concentration and temperature of the magnetic birefringence of nitrobenzene in solution can be explained quantitatively on the assumption that neighbouring molecules are coupled two by two without the occurrence of association as usually understood. [See following Abstract.] C. B. A.

2487. Temperature Variation of Magnetic Birefringence of Polar Liquids. A. Piekara. *Comptes Rendus*, 208. *pp.* 1150–1152, *April* 12, 1939.—It is shown that the theory of "two-by-two" coupling of molecules [see preceding Abstract] can be extended to account accurately for the temperature variation of the magnetic birefringence of nitrobenzene between 20 and 170° C. C. B. A.

2488. Magnetic Circular Dichroism of the Sulphocyanides of Cobalt. J. Verhaeghe, M. van Eyck, and A. Cotton. *Comptes Rendus*, 208. *pp.* 993–995, *March* 27, 1939.—Solutions of $Na_2CO(SCN)_4$ give rise to two absorption bands at visible wave-lengths, both of which contribute to the magnetic rotatory dispersion. The magnetic circular dichroism is now shown to change sign on passing from one band to the other. It is not known whether the two bands are due to the same molecule or to two distinct components in the solution. C. B. A.

2489. Dispersion and Temperature Variation of the Magnetic Rotatory Power of D_2O. G. Dupouy and C. Fert. *Comptes Rendus,* 208. *pp.* 1298–1300, *April* 24, 1939.—The magnetic rotatory power is recorded for D_2O at five visible wave-lengths, and its temperature variation between 0° and 94° C. is measured for the 5461 Å line of Hg. C. B. A.

2490. U.V. Magnetic Rotation Spectra of SO_2 and CS_2. P. Kusch and F. W. Loomis. *Phys. Rev.* 55. *pp.* 850–857, *May* 1, 1939.—The apparatus previously used for the study of magnetic rotation spectra in the visible and infra-red has been modified for use in the u.v. The object was to see whether the simplification often found in magnetic rotation spectra will help in the analysis of the complicated spectra associated with electronic transitions of polyatomic molecules, most of which occur in the u.v. The spectra of this type which have been found are those of CS_2, SO_2 and formaldehyde. In each case the band spectrum is replaced by sharp lines which may readily be correlated to band heads. These spectra occur for only limited regions of the absorption spectrum, in which the band heads are rather sharp and present a regular appearance. In the region where the band heads are irregular, and confused in appearance, no effect occurs. In no case is the magnetic rotation spectrum sufficiently extensive to permit a vibrational analysis of the band system to be made, nor to give any material aid in its analysis. AUTHORS.

See also Abstract 2518.

EMISSION.

2491. Characteristics of Photon Equations. G. Biben. *Comptes Rendus,* 208. *pp.* 883–884, *March* 20, 1939.—Investigation of the mathematical properties of an equation which has been proposed by L. de Broglie as the wave equation of the photon. R. P.

2492. Electromagnetic Quantities in Theory of Photon. G. Petiau. *Comptes Rendus,* 208. *pp.* 969–971, *March* 27, 1939.—The general solution of the wave equation of the de Broglie photon having been already found [see Abstract 2285 (1938)], the quantities defining the electromagnetic field in this theory are now given and the relationships between them discussed. The quantities **E** and **H** are shown to be constructed out of two four-vectors whose physical significance is not, however, given. G. C. McV.

2493. Theory of Radiation. G. A. Schott. *Roy. Soc., Proc.* 171*A*. *pp.* 1–26, *May* 1, 1939.—An attempt is made to account for the observed properties of radiation on classical lines, in particular, the line character of spectra, the Planck-Einstein law ($E = h\nu$), the possibility of interference over long distances, the ionisation of atoms and molecules. The Bohr assumptions are made—existence of stationary states where electron moves in radiationless orbits, and radiation taking place only during transitions between stationary states. The laws of classical dynamics are assumed to hold throughout. The theory developed gives qualitative agreement with facts but is not satisfactory from a quantitative point of view. A. H.

***2494. Heat Radiation from Flames. J. Werneburg.** *Forsch. IngWes.* 10. *pp.* 61–79, *March–April,* 1939. *English Abstract.*—The heat transmission by radiation from flames has hitherto been determined solely by measuring the radiated energy normal to the axis of the flame. It therefore seems necessary exactly to measure the directional distribution of the radiation from the flame. For the heat transmission by radiation from welding flames, moreover, the local intensity of radiation is of importance. Appropriate experimental appliances for both problems are described and the results discussed which have been obtained with them. AUTHOR.

2495. Magnetic Effects on Cosmic Rays. E. M. Bruins. *Ned. T. Natuurk,* 6. 1. *pp.* 2–19, 1939.—Report on recent progress on the influence of the earth's magnetic field on cosmic rays. R. P.

2496. Temporal Variation of Cosmic-Ray Shower Intensity and Mesotron Disintegration. J. Barnóthy and M. Forró. *Zeits. f. Physik,* 112. 3–4. *pp.* 208–214, 1939.—From records of the cosmic-ray shower intensity in Budapest from Dec. 1935 to May, 1936 and from June to Nov., 1937 the variation with barometric, temperature and magnetic conditions is determined as well as the daily variation referred to central European and stellar time. The difference between the barometric and temperature effects of the shower intensity compared with those of the vertical intensity is explained on the theory of mesotron disintegration. J. E. K.

2497. Vertical Counter Effect of Cosmic Rays for Proportional Counters. P. Weisz. *Zeits. f. Physik,* 112. 5–6. *pp.* 364–368, 1939.—According to Kolhörster and Tuwim [see Abstract 1323 (1932)] when a vertical and a horizontal tube counter of equal dimensions and sensitivity are compared the ratio of counts per minute is the reciprocal of the ratio of the average ionisations produced by one particle. If then the amplitude of the counter discharge varies with the ionisation, the above ratio of (vertical to horizontal) counts will increase when the sensitivity of the amplifier is reduced. For a large vapour-filled cosmic-ray counter this ratio was observed to vary from initial values of 0·8 up to 3·0. Assuming in both cases for the amplitudes falling exponential frequency distribution curves—which actually fit the experiments, except for the smallest amplitudes—a simple condition characteristic for proportional counters is derived. In order to see whether it is satisfied for a given counter it is sufficient to take two runs at different sensitivities of the amplifier for each of the two positions of the counter. L. E. F.

2498. Asymptotic Orbits of Primary Cosmic Rays. A. Baños, Jr. *Phys. Rev.* 55. *pp.* 621–623, *April* 1, 1939.—From a comparison of a calculation of an asymptotic family of orbits with the results obtained with the aid of Bush's differential analyser, it is concluded that the precision of the latter is ample for all practical purposes connected with the theory of the main cone of allowed directions and allied topics such as the theory of the latitude and azimuthal effects of cosmic radiation. D. H. F.

2499. Secondary Effects of Cosmic Rays in Pb. T. Grivet-Meyer. *Comptes Rendus,* 208. *pp.* 1216–1218, *April* 17, 1939.—Curves of shower frequencies against Pb thickness up to 20 cm. were measured with a counter-assembly recording showers of 3 particles or more : at sea-level a typical Rossi curve is obtained, with the maximum at 2·2 cm. ; at a water-equivalent depth of 30 m. the curve shows a not very pronounced maximum at 0·12 cm. followed by a plateau ; at a depth of 70 m. the rate rises steeply to about 0·5 cm. and thereafter remains constant. A similarly shaped curve is obtained with an assembly recording 2-particle showers. It is concluded that at sea-level the cosmic radiation contains a component, probably the disintegration electrons of the mesotrons, which disappears underground. It is found that the ratio of the number of penetrating particles to the number of showers under 10 cm. of Pb decreases very markedly with increasing depth. D. H. F.

2500. Stopping Power of Hg and N for Cosmic-Ray Electrons. J. H. Bartlett, Jr. *Phys. Rev.* 55. *pp.* 803–807, *May* 1, 1939.—Form factors have been found for N with the analytic wave functions of Brown, Bartlett and Dunn (see Abstract 4514 (1933)], and for Hg (with a Hartree field). For N, the form factors so found differ appreciably from those computed with a Thomas-Fermi field. For Hg there is not much difference. The formula for the cross-section for impact radiation due to high energy electrons has been revised. There is still a quadratic dependence of $k\phi_k/E_0\overline{\phi}$ on the energy, but the coefficients have been changed, so that this quantity is increased by about 10% for small values of k/E_0. AUTHOR.

2501. Ionising Radiations Emitted by Metals. J. A. Reboul. *Ann. de Physique*, 11. *pp.* 353–458, *April*, 1939.—A detailed account is given of experiments leading to the conclusion that the ionisation apparently produced by ordinary metals (Al, Cu, Fe, Ni, Pb, Sn and Zn were examined) is really partly due directly to cosmic radiation, and only partly to radiation emitted by, and characteristic of, the metal itself under the influence of the cosmic radiation [see Abstract 156 (1938)]. It is then shown that it is to this secondary radiation that the action of metals on a photographic plate is due, but that it is probably, in at least some cases, increased by H_2O_2 produced by the action of this radiation on water vapour. C. A. S.

See also Abstracts 2414, 2510, 2630, 2648.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2502. Fluorescence Test for Striæ and Cords in Glass. M. A. Besborodov and N. O. Abeltchuk. *Soc. Glass Technol., J.* 23. *pp.* 73–75, *Feb.*, 1939.—A fluorescence test is described for the identification of aluminous and siliceous cords in glass. In the test, alumina-rich cords give a yellow fluorescence, but silica-rich cords do not affect the grey fluorescence given by glass in u.v. light. AUTHORS.

2503. U.V. Fluorescence of Alkali Halides with U- and F-Centres. N. N. Fedenew. *Acta Physicochimica*, 9. 6. *pp.* 905–916, 1938. *In German.*—Observations on the u.v. fluorescence of alkali halides containing U- and F-centres lead to the conclusion that electrons may jump from the F-level to the U-level either directly or by way of an intermediate zone. A new U-level has been found which lies at about 0·5 V above the usual U-level. Other transitions have also been observed and the results are interpreted from the standpoint of Tartakowsky's term scheme. [See Abstract 62 (1936).] J. E.

2504. Saturation Effects in Short Duration Photoluminescence of ZnS Phosphors. W. de Groot. *Physica*, 6. *pp.* 393–400, *May*, 1939. *In English.*—The intensity of the fluorescence of some phosphors (ZnS-Cu, ZnS-Ag, ZnS-CdS-Ag, and ZnS-MnS) has been measured in relation to the energy density of the exciting light These substances show a diminution of total intensity of 5-10% at a density of excitation of 5 W/cm². compared with the intensity at a density of excitation of 100 times less. The total emission remains constant. Uranium glass, $K_2UO_2(SO_4 2H_2O$ and a solution of fluorescein in water do not show this saturation effect. J. E.

2505. Silicate Phosphors. G. R. Fonda. *J. Phys. Chem.* **43.** *pp.* 561–577, *May,* 1939.—A zinc silicate phosphor, as well as related ones, can be prepared by firing mixtures of the constituent oxides, with Mn as activator. The reaction is a diffusion phenomenon having a heat of diffusion of 20 to 24 Cal. Its speed depends upon the particle size of the oxides and can be accelerated by the addition of those inert substances capable of dissolving away the barrier shell of silicate as formed. Fluorescence depends upon the presence of Mn. At an optimum concentration of 0·4% Mn it shows a peak at all temperatures and remains almost constant from 100° C. to 77° K. For any concentration above 0·4% Mn the fluorescence increases continuously as the temperature is reduced, approaching the value of the optimum at 77° K. The fluorescence is at a peak for the composition of the orthosilicate but is reduced only slightly when prepared with large excesses of silica. Such phosphors are disintegrated readily by grinding and are simply conglomerates. X-ray examination shows a persistence of the orthosilicate structure throughout. It shows also a stretching of the lattice in the presence of Mn, denoting that the latter enters into the silicate structure by substitution for an occasional Zn atom. Reductions in fluorescence resulting from fusion or from grinding, even when followed by refiring, are due to permanent reductions in crystal size. The complete loss of fluorescence produced by conversion into a glass is a consequence of a decomposition of the double silicate into its constituents. The fluorescence is partially restored by refiring at a temperature below the fusion point. The efficiency of excitation was measured between 2225 and 4047 Å for some silicate and sulphide phosphors. Several of them showed a quantum efficiency of nearly unity for specific wave-lengths. AUTHOR.

2506. Triboluminescence. T. Inoue, M. Kunitomi and E. Shibata. *Hirosima Journ. Sci.* 9. *pp.* 129–136, *March,* 1939. *In German.*—Three arrangements are described for investigating triboluminescence and observations have been made on a number of crystals. A spectrum has been obtained with sugar and appears to be similar to the nitrogen spectrum suggesting that one possible mechanism of triboluminescence is by electrostatic discharges in air round the crystal. But the variety of colour and intensity obtained with various crystals indicates that this cannot be the only mechanism. The fact that pure ZnS, ZnO and BeO do not show triboluminescence while impurities activate these substances suggest that local distortions play a part in the phenomenon. J. E.

2507. Crystalloluminescence. S. Tuda, T. Taketa and E. Shibata. *Hirosima Journ. Sci.* 9. *pp.* 137–144, *March,* 1939. *In German.*—When a substance crystallises out from a melt or solution or is precipitated from solution luminescence is often seen. This crystalloluminescence has been studied quantitatively in the case of As_4O_6, $Ba(ClO_3)_2$ H_2O, $Sr(BrO_3)_2H_2O$, $Ba(BrO_3)_2H_2O$, $Ca(BrO_3)_2H_2O$ and $Na_2SO_4 \cdot 2K_2SO_4$. An apparatus for measuring the total light output is described. It is found that with As_4O_6 the strongest luminescence is obtained by the slowest crystallisation and from the HCl solution in which the substance has the lowest solubility. It is suggested that the explanation of crystalloluminescence is to be found in the mechanism of crystallisation, possibly by the formation of secondary structures which then break down into "blocks," the friction between the blocks resulting in triboluminescence. J. E.

2508. Luminescence During Intermittent Electron Bombardment. R. B. Nelson, R. P. Johnson and W. B. Nottingham. *J. of Applied Physics*, 10. *pp.* 335–342, *May*, 1939.—The dynamic luminescence characteristics of five samples of commercial phosphors excited intermittently by electron bombardment have been studied. The decay of artificial willemite follows closely a simple exponential law, except for a rapid fall during the first three m.sec. after bombardment, the prominence of this component increasing with the current density. An attempt is made to correlate the observed dependence of build-up rate on current density with the phenomenon of current-saturation under continuous bombardment. A sample of calcium tungstate follows changes in the intensity of excitation within 100 μ.sec., the resolving time of the apparatus. Two samples of $ZnS \cdot Ag$ and one sample of $ZnS \cdot CdS \cdot Ag$ decay more rapidly the higher the intensity of excitation. The initial rate for $ZnS \cdot Ag$ is greater than would be predicted for a simple bimolecular reaction, and cannot plausibly be explained by non-uniformity in the initial distribution of reactants in a bimolecular reaction. The $ZnS \cdot CdS \cdot Ag$ decays initially according to a simple bimolecular law. [See Abstract 678 (1939).]

AUTHORS.

INTERFERENCE, DIFFRACTION AND SCATTERING.

2509. Direct Measurement of Intensity Distribution in Fresnel Diffraction Patterns. C. D. Hanse, J. G. Woodward and C. E. McClellan. *J.O.S.A.* 29. *pp.* 147–151, *April*, 1939.—Describes direct photoelectric measurements of the variation of intensity across the diffraction pattern produced when light from a strip source (Hg-vapour lamp) passes through a fine slit. The results obtained are compared with those calculated theoretically and when allowance has been made for the departure from the ideal conditions, a very satisfactory agreement is found.

J. W. T. W.

See also Abstracts 2322, 2323, 2519, 2552, 2591.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2510. Photogenic Effect and Electronic Activation of the $N \equiv N$ Radical. R. Audubert and R. Ralea. *Comptes Rendus*, 208. *pp.* 983–985, *March* 27, 1939.—The thermal decomposition (at about 60°) of IN_3, NI_3. NH_3, and NI_3 has been investigated for the emission of u.v. rays by means of a CuI photo-counter. Only IN_3 gives off u.v. rays on decomposition. This confirms the existence of the $N \equiv N$ radical activated in the N_3 group, and shows that in this type of photogenic reaction the u.v. emission must be due to the deactivation of these radicals.

W. R. A.

See also Abstracts 2560, 2561, 2649.

PHOTOMETRY.

2511. Vectorial Photometry. J. Dourgnon. *R.G.E.* 45. *pp.* 437–440, *April* 8, 1939.—The author discusses the notion of luminous field or vectorial photometry as put forward recently by Gersun and criticised by Blondel. Since the luminous vector represents the difference of the illuminations on either side of a suitably oriented surface, it has not in general a direct physical significance. As a mathematical abstraction, it may be useful in calculations but there is the limitation that it is not in general derivable from a potential. The scalar magnitude, mean brightness about a point, which can be derived from the luminous vector can also be defined in a direct physical manner which is probably more appropriate for the applications in view. Howe's objections to Gersun's tubes of force are shown to arise from a misunderstanding. W. S. S.

See also Abstract

1467B. Photometer for Investigation of Colour Rendering Reproduction of Light Sources. P. M. van Alphen.

POLARISATION.

2512. Depolarisation of Light by Coarse Suspensions. A. Boutaric and J. Breton. *J. de Physique et le Radium,* 10. *pp.* 176–180, *April,* 1939.—A beam of monochromatic polarised light was allowed to fall on a cell containing the suspension, and the coefficient of depolarisation $\rho = i/I$ measured by a photopolarimeter (I and i are intensity of components parallel and perpendicular respectively to the incident vibrations). Suspensions of bentonite, starch, albumen, gelatin, gum arabic, cellulose, amber, NaCl, and emulsions of benzene in H_2O, all show high values of ρ, approaching 0·90 for concentrated suspensions, once the optical density has attained a sufficiently high value. For a given substance ρ is a function of cl only (c = concentration of suspension, l = thickness of cell). For pure liquids, and solutions even of highly anisotropic substances, ρ is almost zero, and is very small for suspensions of metallic particles and opaque substances. Birefringence of the suspended matter may increase ρ but is not necessary to produce the effect. S. J. G.

2513. Measurement of Phase Difference in a Birefringent Optically Active Plate. G. Szivessy and W. Herzog. *Zeits. f. Instrumentenk.* 59. *pp.* 97–115, *March, and pp.* 141–154, *April,* 1939.—In measuring the double refraction of a plate of optically active crystal, the optical activity in directions inclined to the optic axis is usually ignored, as being very small; but more precise methods of measuring birefringence now demand that the effect should be taken into account. New methods are described which depend on the interference effects produced by the plate in parallel plane polarised light falling normally on it, the propagation of light in the crystal being treated by an adaptation of the lattice theories of Ewald and of Born. C. B. A.

2514. Optical Rotatory Powers of (+)-γ-Methyl-*n*-Heptane. J. Kenyon and B. C. Platt. *Chem. Soc., J. pp.* 633–637, *April,* 1939.—The specific rotatory power of (+)-γ-methyl-*n*-heptane [(+)-methylethyl-*n*-butyl-methane] in the homogeneous state remains practically constant with change of temperature; on the other hand, it changes considerably when determined in non-polar solvents. AUTHORS.

2515. Optical Activity of Sugars. E. Gorin, W. Kauzmann and J. Walter. *J. Chem. Phys.* 7. *pp.* 327–338, *May,* 1939.—The optical activities of some pentose sugars have been calculated by using the one-electron theory. The relative signs calculated agree in every case with those experimentally observed while the agreement as to magnitude is satisfactory. Some general considerations concerning the superposition rules are presented. It is shown that the rule is derivable upon the basis of the additivity of the vicinal effects. In addition certain requirements on the structure of the pyranose ring must be fulfilled. [See Abstract 280 (1939).] AUTHORS.

See also Abstract 2535.

REFLECTION, REFRACTION AND DISPERSION.

2516. Optical Properties of Thin Pt Films. Phase Change of 2π in Metallic Reflection. P. Rouard. *Comptes Rendus*, 208. *pp.* 1146–1148, *April* 12, *and pp.* 1294–1296, *April* 24, 1939.—The phase change on reflection of light of various wave-lengths from thin Pt films is measured. At thicknesses less than $3 \cdot 5\,\mu$ it is always a retardation, but with increasing thickness, it changes abruptly to an advance, the change being 2π. The discontinuity, which is observed for all wave-lengths, occurs at the thickness when the reflection factor at the glass-metal surface passes through a minimum. These results can be explained by means of classical formulæ based on electromagnetic theory when the variation of refractive index of the metal with the thickness of the film is taken into account. C. B. A.

***2517. Reflective Power of Metallic Mirrors. H. C. Burger and J. B. van Milaan.** *Physica*, 6. *pp.* 435–438, *May*, 1939. *In English.*—Two mirrors parallel to one another are used, their distance apart deciding the number of reflections which take place when a parallel beam of light impinges on one of the mirrors. The intensity of the emergent beam is measured by means of a vacuum thermocouple and the reflectivity is deduced from the variation in intensity of the reflected beam with number of reflections. A. H.

2518. Reflecting Power of Iron near the Curie-Point and the α/γ-Transition Point. J. H. van der Veen and L. S. Ornstein. *Physica*, 6. *pp.* 439–452, *May*, 1939. *In English.*—It has been found that the reflecting power of iron for visible light as a function of temperature shows a discontinuity of the α/γ-transition point (*ca.* 1200° K.). Within the wave-length region 4500–8500 Å, this discontinuity is independent of the wave-length. At the Curie-point (*ca.* 1050° K.) a continuous anomaly occurs (an extra increase). This anomaly is shown to be dependent on the wave-length. Measurements with polarised light show that in the region of temperature from 300° to 1200° K. the extinction coefficient (k) rises and the refractive index (n) does not change appreciably. AUTHORS.

2519. Adiabatic Piezo-Optic Coefficient of Liquids. V. Raman and K. S. Venkataraman. *Roy. Soc., Proc.* 171*A*. *pp.* 137–147, *May* 19, 1939.—The piezo-optic coefficient defining the change of refractive index of liquids with pressure has till now been measured only for the case of isothermal compression. In such important applications, however, as the theory of the diffraction of light in ultrasonic fields and of the scattering of light in liquids by the Debye waves, it is the effect of adiabatically applied pressure on the refractive index which requires to be known. In the present paper, an experimental technique is described which enables the adiabatic piezo-optic coefficients of liquids to be measured with standard laboratory equipment and actually with greater ease and precision than the corresponding isothermal coefficient. The resulting data for six common liquids are discussed with reference to (1) the deviations from the Lorentz refraction formula, (2) the variation of refractive index with change of temperature when the density is maintained constant, (3) the relation between the adiabatic and isothermal piezo-optic coefficients. These three matters are shown to be closely connected. The data and the discussion based thereupon show clearly that the present technique opens up a field of research which is of considerable interest in relation to the optical properties of liquids and their molecular structure. AUTHORS.

2520. Refractive Dispersions of Optical Glasses in the Photographic Infra-Red. H. Brauckhoff. *Zeits. f. Instrumentenk.* 59. *pp.* 154–162, *April, and pp.* 181–190, *May,* 1939.—A modification of the rotating prism method of Wulff and Anderson is used to measure the refractive indices at wave-lengths in the photographic infra-red for ten standard optical glasses, readings being carried as far as the Na 11,400 Å lines. Simple dispersion formulæ are deduced, and the mean dispersions can be calculated to four places of decimals. It is shown that achromatism can be achieved in the infra-red just as well as in the visible spectrum. C. B. A.

See also Abstracts 2322, 2384, 2502, 2509.

SPECTROSCOPY.

2521. Isotopic Displacement Effect in B Spectrum. S. Mrozowski. *Zeits. f. Physik,* 112. 3–4. *pp.* 223–233, 1939.—The spectrum of B excited in a hollow kathode discharge is investigated with an apparatus of high resolving power. The two lines of the B I doublet 2497–8 Å show an asymmetry which by photometric analysis can be explained as due to a displacement of the line of B^{11} relative to that of B^{10}. The B II line 3451 Å is found to consist of two components attributable to the two isotopes. The mean ratio of the proportions of the isotopes is $B^{11}/B^{10} = 3{\cdot}95 \pm 0{\cdot}1$. L. A. W.

2522. Supplementary Identifications in K, Ca, Sc and Ti Spectra. L. W. Phillips. *Phys. Rev.* 55. *pp.* 708–709, *April* 15, 1939.—About 65 lines, belonging to the Al-like spectra of K and Ca, and the Si-like spectra of Ca, Sc and Ti, are reported. All known term values for these ions are listed. Ionisation potentials for Ca VII and Sc VIII are estimated as approximately 127 and 158 V, respectively. AUTHOR.

2523. Arc Spectrum of Vanadium in the Violet. C. E. Moore. *Phys. Rev.* 55. *pp.* 710–713, *April* 15, 1939.—From new measurements between 2173 and 1848 Å, six new odd terms and 33 miscellaneous odd levels have been found. Almost all lines of intensity 10 and greater have thus been classified, but it has not been possible to fit them all into multiplets. Five of the new terms and one previously known term may form two triads and probably belong to the $(3d)^3 4s \cdot 5p$ configuration. [See Abstract 4184 (1936).] AUTHOR.

2524. Absolute Light Emission, Excitation Functions and Intensity Relations in He, Ne and A Spectra Excited by Atomic Collisions in the Velocity Range 0 to 4500 V. V. Neumann. *Ann. d. Physik,* 34. 7. *pp.* 603–624, *April,* 1939.—Two series of experiments are described, in the first series the He, Ne and A spectra are excited by like neutral atoms and in the second series by unlike atoms. In the first series of experiments the courses of the excitation functions are found to be flatter and the difference between singlet and triplet functions less marked than in the case of excitation by electron collisions. The absolute light emission is 10 to 100 times less than in the case of electronic excitation but the same decrease of intensity as a series is ascended is observed. In the second series of experiments the intensity ratios, but not the absolute values, are found to be independent of the kind of exciting atom. Atoms are more effectively excited by like atoms than by unlike atoms even when the latter have a higher velocity for the same energy as the former but in the case of excitation by unlike atoms the most efficient excitation is given by the atom having the highest velocity for a given energy. J. E. K.

2525. Quadrupole Moment and Magnetic Moment of the $^{127}_{53}$I Nucleus. T. Schmidt. *Zeits. f. Physik,* 112. 3–4. *pp.* 199–207, 1939.—The quadrupole moment and magnetic moment of the $^{127}_{53}$I nucleus are calculated from an analysis of the h.f.s. of the terms $5p^46s\ {}^4P_{3/2,\ 5/2}$ of the I arc spectrum; values of $-0\cdot5 \times 10^{-24}$ and $2\cdot8$ nuclear magnetons respectively are obtained. J. E. K.

2526. Electrical Quadrupole Moment of the Iodine Nucleus. K. Murakawa. *Zeits. f. Physik,* 112. 3–4. *pp.* 234–241, 1939.—Continuing previous work [see Abstract 2883 (1938)] the author analyses the hyperfine structure of further lines of the iodine II spectrum. From the separations of the fine structure terms of $(5s)(5p)^5\ {}^3P_2$ the electrical quadrupole moment of I^{127} is estimated to be $0\cdot8 \,.\, 10^{-24}$. L. A. W.

2527. Nuclear Spins and Magnetic Moments by the *α*-Particle Model. R. G. Sachs. *Phys. Rev.* 55. *pp.* 825–832, *May* 1, 1939.—Some properties of the light nuclei of the type $n\alpha \pm 1$ have been calculated on the basis of the *α*-particle model. By means of this description, spins and magnetic moments of the same nuclei are calculated here. The results for the magnetic moments of many of the nuclei are undetermined within a certain range of possible values since the relative order of magnitude of the spin-orbit coupling and the separation of rotational levels is unknown. This ambiguity does not appear in the Hartree model, so that the magnetic moments as calculated by the two models are somewhat different. The most notable difference occurs for the spins of C^{13}, N^{13}, which have not yet been measured; the Hartree model predicts a spin of $\frac{1}{2}$ for them whereas the *α*-model yields a spin of $1\frac{1}{2}$. The *α*-model appears to give slightly better agreement for those magnetic moments that have been measured. AUTHOR.

2528. Infra-Red Absorption Spectrum of Germane. E. Lee and G. B. B. M. Sutherland. *Cambridge Phil. Soc., Proc.* 35. *pp.* 341–342, *April,* 1939.—The germane band at 2110 cm^{-1}. is found to contain many lines of appreciable intensity not conforming to theory. The cause of the additional lines is not clear but the suggestion is made that they are due to a perturbation of the rotational levels. A. H.

2529. Infra-Red Absorption Spectra of Hydrocarbons and Heterocyclic Compounds of High Molecular Weight. P. Lambert and J. Lecomte. *Comptes Rendus,* 208. *pp.* 1148–1150, *April* 12, 1939.—Infra-red absorption spectra between 525 and 1400 cm^{-1}. are measured for indene, indole, cumarone, thionaphthene, hydrindene, anthracene, *β*-methylanthracene, 2 : 3-benzanthracene, acridine, xanthene, thiodiphenylamine and 1 : 2-benzanthracene, either in solution in CS_2, or as thin solid films, or as powders. The results are discussed from the point of view of symmetry relationships. C. B. A.

2530. Infra-Red Absorption of the Phenylmethanes. F. T. Wall and G. W. McMillan. *Am. Chem. Soc., J.* 61. *pp.* 1053–1055, *May,* 1939.—The infra-red absorption spectra of the phenylmethanes and benzene have been investigated in the range $3\cdot2$–$3\cdot6\ \mu$. The results are correlated with the structures of the molecules and force constants are calculated for the different carbon-hydrogen bonds. AUTHORS.

2531. Structure and Absorption Spectra of Coloured Hydroxy-Derivatives of Triphenylmethane. P. Ramart-Lucas. *Comptes Rendus,* 208. *pp.* 1094–1096, *April* 3, *and pp.* 1312–1314, *April* 24, 1939.—The absorption spectra of fuchsone, phenolphthalein sulphone, aurine, benzaurine, thymophthalein sulphone, and of various oxygenated and brominated derivatives are studied. The results indicate that, in solution, the hydroxyfuchsones exist in two isomeric forms, one of which is similar to fuchsone itself, and that there are three forms of the phenolphthalein sulphones and two of the phenolphthaleins. The isomerism depends on differences between the valency angles of corresponding atoms in the various forms. C. B. A.

2532. Far Infra-Red Combination Frequencies and Existence of Metal-Hydrate Complexes in Crystals. K. H. Hellwege. *Ann. d. Physik*, 34. 6. *pp.* 521–540, *March*, 1939.—Reflection measurements in the region 20–56 μ have been made on 8 sulphates with a grating spectrometer. In the frequency region between reststrahlen and internal vibrations a system of weak bands has been found. It seems highly probable that they are combination tones of the individual reststrahlen and their intensity is taken as an indication of the anharmonicity of the crystal forces. For potassium and for chrome alum sharp reststrahlen bands occur at $37 \cdot 6\mu$ and $41 \cdot 3\mu$. By replacement of the water of crystallisation by D_2O the reststrahlen band of potassium alum is so far displaced towards longer waves that it must be assumed that the water of crystallisation is coordinated with the metal ions. In a series of simple sulphates the relative positions of the reststrahlen are determined only by the reduced masses, the lattice forces being to a first approximation constant. This again indicates the existence of stable metal-hydrate complexes. The surrounding of the metal ions with a water shell leads to a weakening of the reststrahlen bands and a strengthening of the combination bands in the hydrated sulphates. This effect is especially strong in hydrates with unsymmetrically bound water molecules, *e.g.*, Epsom salt and copper sulphate. J. E.

***2533. Band Spectra in Nitrogen at Atmospheric Pressure. Source of Band Spectra Excitation. O. R. Wulf and E. H. Melvin.** *Phys. Rev.* 55. *pp.* 687–691, *April* 15, 1939.—An apparatus, essentially an ozoniser, consisting of a cylindrical condenser, a portion of the dielectric of which is a gas, has been used as a source of band spectra excitation. Such a source can be operated with the gas at 1 atm. and at a temperature which is practically that of the walls. N_2 bands $A \rightarrow X$ have been photographed in emission at 1 atm. under resolution sufficient to permit measurement of part of their rotational structure. The rotational structure of four of the present bands has been computed by using the rotational constants which have been determined from other band systems in N_2. The agreement with the measured values is satisfactory, and makes more certain the identification of this band system. The alternation of intensity in the rotational lines is clearly visible, measurements indicating that the ratio of the intensities is 2 : 1. In this source of excitation the first positive group of N_2 is considerably weaker relative to the second positive group than in an ordinary glow discharge. The rather striking difference between this type of source and a h.v., low current arc at 1 atm. is illustrated by band spectra in O_2 containing a small amount of N_2. In the latter source the principal emission is the Runge bands of O_2 while in the former the only prominent material is the second positive group of N_2. AUTHORS.

2534. Absorption Spectra of Salicylic Acid and its Alkali Salts in Aqueous Solution. Choong Shin-Piaw. *Comptes Rendus*, 208. *pp.* 1292–1294, *April* 24, 1939.—The absorption spectra of aqueous solutions of salicylic acid and its Li, Na, and K salts have been determined.

They lie in the u.v. and consist of two bands A (approximately 3000–2570 Å) and B (approximately 2300–2210 Å). For a given concentration the position of the A band of the salts does not vary regularly with the molecular weight of the salt, contrary to theory. The B band of the acid itself disappears in very dilute solutions. The maximum and minimum of the A band are displaced towards the shorter waves with decreasing concentration. It is concluded that in the cases of salicylic acid there is still an appreciable number of undissociated molecules in a 0·007 *N* solution. In a 0·00007 *N* solution the acid is approximately completely dissociated. It is supposed that the oscillator responsible for the B band is the OH of the carboxyl of the acid. This is destroyed when the acid is completely dissociated. A. J. M.

2535. Absorption Spectra of Single Crystals of Hæmoglobin in Polarised Light. M. F. Perutz. *Nature,* **143.** *pp.* 731–733, *April* 29, **1939.**—The absorption spectra of single crystals of hæmoglobin in polarised light have been examined. In met- and oxy-hæmoglobin of horse and in methæmoglobin of sheep, the width and strength of the absorption bands was dependent on the vibration direction of the polarised light. The results indicate an approximate parallelism of the four hæme groups in the met- and oxy-hæmoglobin molecule. AUTHOR.

2536. Fine Structure of Residual Rays. M. Blackman. *Zeits. f. Physik,* 112. 3–4. *p.* 256, **1939.**—A brief emendation to the theoretical treatment in a previous publication [see Abstract 40 (1937)]. L. A. W.

2537. Vibrations of Molecules of Deutero-Ethylene. E. Bernard and C. Manneback. *Ann. Soc. Sci. de Bruxelles,* **59.** *pp.* 113–124, *March* 31, **1939.**—In previous calculations the "gauches" frequencies (*i.e.,* those perpendicular to the plane of the molecule) have been neglected. These have now been calculated for C_2H_4, C_2D_4, C_2H_3D, C_2HD_3, and *cis-*, *trans-*, and asymmetrical $C_2H_2D_2$. W. R. A.

2538. Intensities of Electronic Transitions in Molecular Spectra. Parts IV, V, VI and VII. R. S. Mulliken. *J. Chem. Phys.* 7. *pp.* 339–373, *May,* **1939.**—Continuing on the lines of earlier work [see Abstract 1684 (1939)] the spectra of a number of dienes are considered in which the spectra depart from the open chain conjugated type; the cause of the departure is designated as hyperconjugation—a mild type of conjugation. Observed spectral displacements to longer wave-lengths and refractivity effects are attributed to this. The spectrum of benzene is also discussed. In connection with the spectral intensity calculations a study is also made of the molecular refractivities for the substances under review and qualitative agreement obtained with experiment. Finally, the observed absorption spectra of conjugated polyenes and their derivatives are compared with the results of theoretical calculations on various models of butadiene, octatetraene and β-carotene. A. H.

2539. Antisymmetric Molecular Orbitals. Part II. Calculation of Integrals. A. L. Sklar and R. H. Lyddane. *J. Chem. Phys.* 7. *pp.* 374–379, *May,* **1939.**—The integrals which are common to the application of the method of antisymmetric molecular orbitals to unsaturated as well as to aromatic molecules are tabulated. Accordingly, all integrals are evaluated with $2p\pi$ H-like functions. Tables are given for the Coulomb (*aa*; *bb*), exchange (*ab*; *ab*), and hybrid Coulomb exchange (*ab*; *bb*) repulsions of two electrons, and for the Coulomb and exchange attraction of a carbon ion for an electron. [See Abstract 4547 (1938).] AUTHORS.

2540. Electronic Energy of Ground State of Methane. M. M. Biedermann and S. R. de Groot. *Physica,* 6. *pp.* 421–424, *May,* 1939. *In English.*—The electronic energy of a CH_4-molecule is calculated in zero-th order approximation for the model of four H^--ions and one central C^{++++}-ion, neglecting the electron exchange. Owing to the small distance of the ions, the usual treatment of electron exchange (*i.e.*, reduction to interaction between pairs of ions) is not sufficient in this case. AUTHORS.

2541. Continuous Emission Spectrum Accompanying the Resonance Lines of Neon. T. Takamine, T. Suga, Y. Tanaka and G. Imotani. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 893. *pp.* 447–454, *April,* 1939.—When a condensed discharge is passed through a Ne tube containing a small amount of N_2, a continuous emission spectrum, extending to about 50 Å, is observed on the longer wave-length side of the resonance line of Ne 744 Å. From the fact that the longer wave-length limit of this emission continuum corresponds energetically to the $^3\Sigma_g^+(X')$ level of the molecular N_2, it seems likely that the phenomenon shows a certain resonance effect between the excited Ne atoms and the N_2 molecules. AUTHORS.

2542. U.V. Absorption by Organic Substances. J. Cholewinski, L. Marchlewski and W. Bednarczyk. *Acad. Polonaise Sci. et Lettres, Bull.* 8–10*A. pp.* 519–540, *Oct.–Dec.,* 1938. *In English.*—Continuing previous work [see Abstract 223 (1938)] the absorption of u.v. light by the following substances is examined—indigotin, indirubin, sorbose, alloxane and a number of related compounds. A. H.

2543. Continuous Atomic Absorption of Light. T. L. Page. *Roy. Astron. Soc., M.N.* 99. *pp.* 385–396, *Feb.,* 1939.—A survey article covering both the theoretical and experimental aspects of the subject. The conclusion is reached that much more work is necessary before it is possible to make reliable inferences as to the general absorption by a large variety of atoms, especially in the outer layers of a star where the radiation is mainly in optical wave-lengths. A. H.

2544. Visible Fluorescence Spectrum of HgCl and Heat of Formation of $HgCl_2$ in Vapour Form. K. Wieland. *Zeits. f. phys. Chem.* 42. *Abt.B.* 6. *pp.* 422–431, 1939.—The spectrum B of HgCl (from 5600 to 3100 Å) as emitted from a Geissler tube filled with $HgCl_2$, is too complicated for analysis, but is simplified by fluorescence excitation, especially when a foreign gas such as N_2 is added. Vibrational analysis becomes possible, and the value $Q_2 = 26$ kg.cal. is deduced for the heat of dissociation of HgCl in the ground state. The value $Q_1 = 77$ kg.cal. for the heat of dissociation of $HgCl_2$ according to the equation $HgCl_2 = HgCl + Cl$ is deduced from the normal fluorescence spectrum in absence of added foreign gas. Hence the heat of formation of $HgCl_2$ vapour, $Q_1 + Q_2$, comes out to 103 kg.cal. with an estimated errors of ± 5 kg.cal. This is in agreement with the thermochemically determined value. L. A. W.

2545. Zeeman Effect of Hyperfine Structure of Hg. L. Sibaiya and T. S. Subbaraya. *Indian Acad. Sci., Proc.* 9*A. pp.* 211–218, *March,* 1939.—The Zeeman effect of the hyperfine structure of the Hg green line λ5461 has been studied at field strengths up to 4000 gauss. The results show good agreement with theory both as regards separations and intensities. A. H.

2546. Stark-Effect Broadening of Hydrogen Lines. Part I. Single Encounters. L. Spitzer, Jr. *Phys. Rev.* **55.** *pp.* **699–708,** *April* **15, 1939.**—The profile of a H emission line is investigated on the assumption that the H atom is perturbed by passing ions. Provided that the ions do not approach to within ten times the average atomic radius the electric field of the ion may be assumed homogeneous and the matrix elements calculated for the usual Stark effect may be used. For a collision at low velocity or with close approach, the adiabatic approximation is valid, and the profile depends solely on the total phase shift produced by the collision. The Fourier analysis of the wave train may be carried through exactly for certain values of this phase shift. Nonadiabatic transitions are examined for the lowest lines, and an exact solution given for this case also. For higher lines a modified Born approximation is used. The Weisskopf collision broadening formula is shown to hold only in certain cases, and the dispersion curve smearing function for impact broadening is shown to lead in some instances to incorrect results. AUTHOR.

2547. Smekal-Raman Effect. K. W. F. Kohlrausch. *Die Physik,* 7. 2. *pp.* 79–88, 1939.—A review with numerous literature references. L. A. W.

2548. Raman Effect in Relation to Crystal Structure. S. Bhagavantam and T. Venkatarayudu. *Indian Acad. Sci., Proc.* 9*A.* *pp.* 224–258, *March,* 1939.—A theory of the normal oscillations of crystal lattices is presented. The selection rules in respect of Raman effect for various types of normal oscillations are considered in detail. The method of obtaining the normal coordinates is indicated. The normal modes of oscillations of some typical crystal lattices are worked out with the help of this theory. They have been classified as translational, lattice and internal oscillations and the selection rules appropriate to Raman effect and infra-red absorption are given in each case. The manner in which the normal modes of free ions and molecules combine or modify to give the modes of the corresponding crystals is discussed in detail. The available experimental results are compared with the theoretical conclusions. In view of its importance, the case of calcite is dealt with at some length both in regard to its normal modes and the directional excitation of Raman effect. Amongst the general results that have been obtained, mention may be made of the following. When a group of atoms constituting an ion or a molecule goes to build up a crystal, its normal modes usually undergo three types of modifications, namely, splitting of degenerate vibrations, multiplicity due to the unit cell containing more than one molecule and alterations in selection rules. Accordingly some of the Raman lines that appear in the liquids or solutions may split into components in the corresponding crystals or may fail to appear or may appear along with some new Raman lines. The lattice oscillations are divided into two groups, namely, translational and rotational. It is observed that the low frequency Raman bands recorded in solid organic substances are of this type and that no special mechanism need be postulated for explaining their presence. AUTHORS.

2549. Raman Effect and Potential Function of the Ethylene Molecule. M. de Hemptinne and C. Manneback. *Indian Acad. Sci., Proc.* 9*A.* *pp.* 286–302, *March,* 1939.—It is shown that 32 Raman lines and 7 infra-red bands of the deutero-ethylenes can be accounted for with a maximum error of 1·3% by using a potential function with 15 constants and one anharmonic constant. The average discrepancy between calculated and observed frequencies is 0·24%. This agreement is taken as evidence for the physical reality of the interaction terms introduced into the potential function. L. A. W.

2550. Infra-Red and Raman Spectra of C_2D_6. F. Stitt. *J. Chem. Phys.* 7. *pp.* 297–307, *May*, 1939.—The infra-red spectrum of gaseous C_2D_6 has been investigated from 2 to 22μ, and the Raman spectrum of the liquid has been photographed. These data have been analysed for both the symmetries D_{3d} and D_{3h}. It is concluded that the equilibrium configuration of ethane cannot be reliably determined from the analysis of the data now available on the vibrational spectra of C_2H_6 and C_2D_6. However, the " uncertain frequency " of C_2H_6 is determined by application of the product rule if the symmetry is D_{3d}. A modified valence force type potential function containing interaction terms between the two methyl groups is found to fit the fundamental frequencies of the light and heavy ethanes quite well. [See Abstract 2565 (1939).] AUTHOR.

2551. Infra-Red and Raman Spectra of Dimethyl Ether. B. L. Crawford, Jr, and L. Joyce. *J. Chem. Phys.* 7. *pp.* 307–310, *May*, 1939.—The infra-red spectrum of dimethyl ether has been studied from 2·5 to 22·5μ, and the available Raman data correlated with it. A tentative vibrational analysis is given. AUTHORS.

See also Abstracts 2350, 2433, 2509, 2564, 2587, 2601.

TRANSMISSION.

2552. Effect Observed with a Rotating Sagnac Disc when Part of the Optical Circuit is Fixed. A. Dufour and F. Prunier. *Comptes Rendus*, 208. *pp.* 988–990, *March* 27, 1939.—Results of experiments with a rotating Sagnac disc in which part of the optical circuit is fixed and separate from the disc can be explained on the assumption that the velocity of light relative to an observer moving with the disc depends on his linear velocity. [See Abstract 4005 (1937).] C. B. A.

See also Abstracts 2433, 2575.

VISION.

*2553. **Theory and Measurement of Visual Mechanisms. W. J. Crozier and A. H. Holway.** *J. Gen. Physiol.* 22. *pp.* 341–364, *Jan.*, 1939.—A visual discriminometer is described which has been designed to enable as many different types of visual observation as possible to be made with it. These include intensity discrimination, flicker, colour mixture, sensory bisection, equal brilliance steps and visual acuity. Provision is also made for binocular as well as monocular viewing. Results are described using this apparatus to measure the monocular and binocular thresholds across the horizontal meridian of the human retina. No direct correlation was found between the sensitivity at any given point of the retina with the number of retinal elements at that point. Binocular sensitivity was generally greater than monocular sensitivity by a factor of 1·4. The results are consistent with the localisation of the mechanism responsible for the threshold response in the central nervous system. W. D. W.

2554. Visual Threshold Values. E. M. Beattie. *Roy. Soc. Edinburgh, Proc.* 59. 1. *pp.* 55–61, 1938–1939.—Experiments were made to measure the effect of exposing the eye to a bright source on the critical frequency of flicker. Two intensities of adaptation were used and the time of adaptation was varied over a range of 60 sec. The critical frequency was also measured at various times up to 5 min. during recovery from the adaptation. It was found that the recovery curves obtained did not follow any simple exponential law. W. D. W.

2555. Electrical Response of Dark-Adapted Grasshopper Eye. F. Crescitelli and T. L. Jahn. *J. Cell. and Comp. Physiol.* 13. *pp.* 105–112, *Feb.*, 1939.—The electrical response of the dark-adapted grasshopper eye has been measured for various intensities of white and coloured light of short duration. At very low intensities the response is diphasic, but as the intensity is increased, the positive phase decreases while the negative increases. No differences of wave-form obtained with different colours were observed that could not be attributed entirely to differences in relative sensitivity to the colours used. The variation of the response with wave-length gives a curve somewhat similar to the absorption curve of visual purple. [See following Abstract.] W. D. W.

2556. Electrical Response of the Moth Eye. T. L. Jahn and F. Crescitelli. *J. Cell. and Comp. Physiol.* 13. *pp.* 113–119, *Feb.*, 1939.—The electrical response of both the dark- and light-adapted eye of the Cecropia moth has been measured. With increase in intensity of the stimulating light, the response is increased, but the response in the light-adapted eye is greatly reduced and altered in form. The curve between the response and wave-length is generally similar to the absorption curve of visual purple. No specific effects of wave-length were detected. [See preceding Abstract.] W. D. W.

X-RAYS.

2557. Long Curved X-Ray Spectral Lines by Method of Convergent X-Rays. T. Fujiwara and D. Onoyama. *Hirosima Journ. Sci.* 9. *pp.* 115–123, *March*, 1939. *In English.*—Long curved X-ray spectral lines were obtained by using the improved method of convergent X-rays, and a method was devised for determining the glancing angles of the spectral lines on the atomic planes of the crystal, the indices of the atomic planes by which the spectral lines are reflected, and the orientation of the crystal. The mechanism of existence of X-ray patterns, especially light and dark lines appearing as pairs, in the central black part of a radiograph taken by the method of convergent X-rays is also briefly discussed. [See following Abstract.] AUTHORS.

2558. Light and Dark X-Ray Diffraction Patterns Formed as Pairs by Convergent X-Rays. D. Onoyama. *Hirosima Journ. Sci.* 9. *pp.* 125–128, *March*, 1939. *In English.*—The radiograph was taken with a thin single crystal, by the improved method of convergent X-rays [see preceding Abstract], and an examination was made of its central black part, impressed by the primary incident beam of convergent X-rays. A number of light diffraction patterns, and a number of light and dark lines appearing as pairs, were found. The results are described. AUTHOR.

2559. Atomic Scattering Factors of Important Ions. G. Dascola. *Zeits. f. Krist.* 100. 6. *pp.* 537–539, 1939.—The atomic scattering factors of a series of 17 ions, ranging from Na^+ to Bi^{3+}, are calculated by the method of v. Sz. Nagy; and curves are given, for Na^+, K^+, Ca^{2+} and Cu^+, in which the results are compared with those obtained by other methods. The differences between the author's curves and those calculated from the original Hartree electron distribution are of the same order as those found by Pauling and Sherman, Derenzini and James and Brindley. J. T.

2560. Changes in Mineral Oil Due to X-Rays or U.V. Radiation. W. Stenstrom and I. Vigness. *J. Phys. Chem.* **43.** *pp.* 531–544, *April*, 1939.—A heavy mineral oil, "Bacol," was irradiated with X-rays or u.v. radiation. The products were investigated by (*a*) their u.v. absorption curves, (*b*) their spreading behaviour on various dilute aqueous solutions [see Abstract 4973 (1938)], (*c*) chemical methods. In absence of O_2, a small fraction of the molecules acquire either single or multiple unsaturated linkages, whilst in presence of O_2, a small quantity of unsaturated fatty acids is formed in addition. 100 kiloroentgens of X-rays yield > 10 parts of unsaturated molecules, including 1 part of acid, per 5×10^4 hydrocarbon molecules. The spreading behaviour of oils on water provides a sensitive means for the detection and to some extent identification of small contents of fatty acids. These spreading properties are greatly modified by presence of impurities, particularly Ca^{++} ions, in the water. S. J. G.

2561. Influence of Pressure on X-Ray Sensitivity of Photographic Films. S. S. Lu, Chang Hung-Chi and Lü Ta-Yuan. *Comptes Rendus*, **208.** *pp.* 1296–1297, *April* 24, 1939.—Application of pressure diminishes the sensitivity of Kodak and Agfa X-ray films, but increases that of Ilford film. The ratio of density of image under pressure to normal density depends only on the pressure. When account is taken of the image produced on Ilford film by mechanical pressure alone, the sensitivity is found to increase at low pressures but to decrease at high ones. It is suggested that two opposing effects are involved, one occurring generally for visible and u.v. wave-lengths, and the other for X- and γ-rays. These are comparable in the case of Ilford film. C. B. A.

2562. X-Ray Study of Pictures. F. I. G. Rawlins. *Brit. J. of Radiology*, **12.** *pp.* 239–245, *April*, 1939.—This paper is a survey of the use of X-rays in the study of pictures. X-rays can be used to reveal how much of the original picture is left, whether the picture is the work of more than one artist and thirdly to study the technique of the great masters. In designing a suitable X-ray apparatus the following factors must be considered :—the support (usually wood or canvas), the ground, the paint film, and the surface film (varnish). The usual object is to obtain as much information as possible about the paint film ; experience has shown that for photography the following conditions are the best, 10-15 kV and a current of about 15 mA. Whilst for screening work 25 kV and 5 mA are most suitable. The apparatus used at the National Gallery is described and illustrative photographs are reproduced. G. G.

***2563. Multiple Exposure X-Ray Spectrometer. A. R. Ubbelohde.** *Journ. Sci. Instruments*, **16.** *pp.* 155–161, *May*, 1939.—A multiple exposure X-ray spectrometer which has been constructed for measuring small changes in lattice spacing of crystals, resulting from various physicochemical operations. The instrument is suitable for both powder and single crystal photographs, and the specimen can be investigated either *in vacuo*, or in any desired gas. Various experimental errors which arise in determining the position of an X-ray reflection can be directly evaluated on the spectrometer itself. Its use in measuring isotope effects in crystals is illustrated by typical X-ray spectra comparing $(CONH_2)_2$ with $CO(ND_2)_2$ and KH_2PO_4 with KD_2PO_4. AUTHOR.

See also Abstracts

1359B. Production of X-Rays in Braun Tubes. H. Bode and H. Glöde.
1416B. Scattered X-Ray Radiation. E. Brandenberger.

HEAT.

CALORIMETRY.

2564. Gaseous Heat Capacities. Part I. Method and Heat Capacities of C_2H_6 and C_2D_6. G. B. Kistiakowsky and W. W. Rice. *J. Chem. Phys.* 7. *pp.* 281–288, *May,* 1939.—An apparatus is described for the adiabatic expansion method of Lummer and Pringsheim, new features of which are a device for accurate and rapid pressure measurements and an effective design of the expansion vessel. The Wollaston wires, serving as a resistance thermometer, are subjected to extensive heat treatment which stabilises their electrical characteristics so well that resistance changes accompanying gas expansion can be translated into temperature changes by means of separately determined temperature coefficients of resistance. The method here described is thus an absolute one and is not dependent on comparison with other gases of known heat capacity. Causes of imperfect temperature constancy after expansion are quantitatively discussed and traced to two processes: the heat conduction by the gas and the absorption of thermal radiation from the walls by the gas. Experimental data on air and CO_2 are presented and are compared with the theoretical values. Heat capacities of C_2H_6 and C_2D_6 are reported for the interval 0 to 90° C. [See following Abstract.] AUTHORS.

2565. Low Temperature Gaseous Heat Capacities of C_2H_6 and C_2D_6. G. B. Kistiakowsky, J. R. Lacher and F. Stitt. *J. Chem. Phys.* 7. *pp.* 289–296, *May,* 1939.—The heat capacities of gaseous C_2H_6 and C_2D_6 have been measured down to 93° K. with the low pressure thermal conductivity apparatus previously described [see Abstract 754 (1938)]. An improved cryostat and better designed conductivity cells were used. A new method of obtaining the heat capacities from the thermal conductivity data is described which does not require a knowledge of the accommodation coefficient α. It is based on the assumption that when the accommodating efficiency of the wire is changed, α changes in the same direction for the gases being compared and further that the percentage change in α is greater the more its absolute value deviates from unity. It is then possible to show that the unknown α for the gas being studied can be bracketed within narrow limits by the α's of comparison gases. The heat capacity results for light and heavy ethane indicate a potential barrier restricting internal rotation of essentially sinusoidal shape and with a depth of 2750 cal./mol. [See preceding Abstract and Abstract 2550 (1939).] AUTHORS.

2566. Specific Heats at Low Temperatures of BeO and Be_2SiO_4 (Phenacite). K. K. Kelley. *Am. Chem. Soc., J.* 61. *pp.* 1217–1218, *May,* 1939.—Specific heat measurements of BeO and Be_2SiO_4 were made covering the temperature range 52·5 to 298·1° K. The entropies are $S_{298 \cdot 1} = 3 \cdot 37 \pm 0 \cdot 5$ for BeO and $S_{298 \cdot 1} = 15 \cdot 4 \pm 0 \cdot 1$ for Be_2SiO_4. The value $\Delta F^{\circ}_{298 \cdot 1} = -140{,}320$ is given as the free energy of formation of BeO.

2567. Atomic Heat of K. L. G. Carpenter and C. J. Steward. *Phil. Mag.* 27. *pp.* 551–564, *May*, 1939.—The paper gives the results of measurement of the true (as opposed to the mean) atomic heat of K over a temperature range of 203° to 609° K. It was found that C_v exceeds the equipartition value of 3 R at about 200° K., and that at about 250° K. it begins to increase appreciably, but in a manner which the authors consider cannot be attributed to impurity. The effect is considered to be associated with lattice vibrations, and not with electrons. In the liquid phase also C_v is found considerably to exceed 3 R. The latent heat of fusion was measured and was found to be 0·568 kg.cal./gm.-atom.
L. G. C.

***2568. Precision Measurements of Heats of Evaporation of Gases O_2, H_2S, PH_3, A, COS, CH_4 and CH_3D. A. Frank and K. Clusius.** *Zeits. f. phys. Chem.* 42. *Abt.B.* 6. *pp.* 395–421, 1939.—Apparatus and technique are described by which the heats of evaporation of liquefied gases can be measured precisely using only about 0·35 moles of material. Special attention is paid to correction for heat losses by extrapolation to infinitely rapid evaporation. An account is given of the preparation and purification of the gases investigated and finally the heats of evaporation are given with a mean error of ± 0·1%. L. A. W.

See also Abstract 2550.

CONDUCTION.

2569. Determination of Thermal Conductivity and Diffusivity. J. Fischer. *Ann. d. Physik*, 34. 8. *pp.* 669–688, *April*, 1939.—A detailed theoretical account is given of the method recently proposed by both Pfreim (*V.D.I.* 82. *p.* 71, 1938) and Eucken and Englert [see Abstract 3300 (1938)] for the determination of thermal conductivity. This method is based on Schleiermacher's hot-wire method, but observations are made during the variable state, the thermal conductivity being calculated from the rate of temperature rise of the wire when carrying a steady current. An expression for the conductivity is obtained in the general case, and approximate formulæ derived for the particular case where the cross-section of the wire is small compared with that of the tube. A modification in the original method is proposed, that the central wire be used only as a thermometer. This has certain advantages. The corresponding expressions for the conductivity as a result of the modification are worked out. The author's expressions are compared with those given by Pfreim and by Eucken and Englert, which are shown to lose their validity outside a certain limit. Numerical examples are given which demonstrate the considerable differences between the author's and previous expressions, and the differences between the original method and the proposed modification. Finally, a treatment similar to that for the hot-wire method is given for the plate method. S. W.

2570. Influence of Pressure on Thermal Conductivity of Liquid He II. J. F. Allen and E. Ganz. *Roy. Soc., Proc.* 171 *A.* *pp.* 242–250, *May* 19, 1939.—Graphs of the thermal conductivity of liquid He II are given for constant temperatures (1·173°–2·082° Abs.) and pressures

0–25 atm., and for constant pressures (0–20 atm.) at temperatures 1·17°–2·19° Abs. From the λ-point (2·186° Abs.) down to about 1·6° Abs. the pressure coefficient of conductivity is negative, and below 1·6° Abs. the coefficient is positive but small. For pressures close to the λ-line or the solidus curve the conductivity appears to be related linearly to the pressure. Determinations of the conductivity of solid He at 1·4° Abs. for pressures 30–60 atm. and at 2·0° Abs. for a pressure of 60 atm. show that the conductivity of solid He is more than 1000 times smaller than that of liquid He II. For temperature gradients of the order $10^{-3°}$ Abs./cm., a large proportion of the heat transfer in liquid He II is effected by some form of mass transfer, not due to convection currents. The mechanism of heat transport is hindered by compression of He II; the negative pressure coefficient of conductivity between 1·63° and 1·85° Abs. is attributable to increased hindrance to motion of the He II atoms when the liquid is compressed. J. S. G. T.

***2571. Thermal Conductance of Metallic Contacts. R. B. Jacobs and C. Starr.** *Rev. Sci. Instruments*, 10. *pp.* 140–141, *April*, 1939.—The thermal conductance between two clean metallic surfaces, in contact in a vacuum, is of importance for the design of cryogenic apparatus. The thermal conductances between various surfaces in a high vacuum were studied as a function of contact pressure, and results are given for Au, Ag and Cu at 25° C. and − 195° C. The surfaces were polished to approximately optical flatness. S. W.

See also Abstract 2343 and
1350B. Conductivities of Irons and Steels. R. W. Powell.

CONVECTION.

2572. Convection of Heat in Fluid Flowing Normally to Axis of Cylinder. G. Ribaud. *Comptes Rendus*, 208. *pp.* 1139–1141, *April* 12, 1939.—A theory is developed which leads to the empirical formula of Ulsamer. A. J. M.

2573. Heat Transfer from Hot Wires. W. Elenbaas. *Ned. T. Natuurk.* 6. 5–6. *pp.* 77–88, 1939.—Using the hydrodynamical theory of heat transfer in the case of heat convection and also Langmuir's theory, the expression $G = B_0 N^3 e^{-6/N}$ is obtained, where B_0 is a dimensionless number which for horizontal cylinders in gases with two atoms per molecule is 8, N is the Nuszelt number and G the Grashof number. This formula fits the experimental results very well. At high pressures the transfer is proportional to the 2/3 power of the pressure and this is found experimentally to be the case in Kr at high pressures for the heat lost from a coiled-coil filament. The rate of evaporation, which is determined by measuring the life of a filament, multiplied by the pressure is proportional to the heat transfer. G. G.

See also Abstracts 2332, 2574.

DILATATION.

See Abstract 2309.

FUSION AND SOLIDIFICATION.

2574. Resistance, Emissivities and Melting Point of Tantalum. L. Malter and D. B. Langmuir. *Phys. Rev.* 55. *pp.* 743–747, *April* 15, 1939.—The relation between true and brightness temperatures of Ta was determined by means of pyrometric observations on the inside and outside of a long thin-walled tube heated electrically. The brightness temperature as a function of heating current was determined by sighting on an electrically heated wire of known diameter. Potential leads of fine W wire welded to Ta filaments permitted a determination of the electrical properties as a function of temperature. The electrical properties at the melting point yielded a value for this quantity from the extrapolated temperature *vs.* electrical property relations. Value for the melting point determined is 3269° K. [See Abstract 2584 (1939).] AUTHORS.

See also Abstracts 2285, 2607.

TEMPERATURE.

2575. Temperature Corrections in Optical Pyrometry. F. Benford. *J.O.S.A.* 29. *pp.* 162–163, *April*, 1939.—Gives a chart from which may be read the temperature correction at any given brightness temperature (as determined on an optical pyrometer) on account of either emissivity or absorption due to intervening glass surfaces. For example, at an observed temperature of 2000° K., if the body is observed through a glass bulb having a transmission factor of 0·9, the true temperature is 2020° K. A number of worked examples are given in the paper. J. W. T. W.

See also Abstracts 2570, 2571, 2574.

THERMOCHEMISTRY.

2576. Influence of NO_2 on Ignition of Hydrocarbons. G. P. Kane. *Roy. Soc., Proc.* 171*A. pp.* 251–269, *May* 19, 1939.—A study is made of the effect of NO_2 on the spontaneous ignition of higher hydrocarbon-oxygen media. Above 430° C., *i.e.*, above the region of cool flames NO_2 promotes ignition in concentrations up to 6%. At lower temperatures in the two-stage ignition region NO_2 inhibits the cool flames and promotes the direct oxidation of the hydrocarbon. With propane and 3·25% NO_2 the cool flames can no longer be observed. With *n*-butane 5% NO_2 is needed to inhibit the cool flames, but with large amounts of NO_2 an anticatalytic effect is seen. And a similar result is observed with acetaldehyde. A theoretical interpretation of these results is given as well as a discussion of their bearing on " knock." G. G.

See also Abstract 2544.

THERMODYNAMICS.

2577. Critical Constants of Ethane. J. A. Beattie, Gouq-Jen Su and G. L. Simard. *Am. Chem. Soc., J.* 61. *pp.* 924–925, *April*, 1939.—The critical constants of C_2H_6 (mol. wt. 30·0462) are : $t_c = 32 \cdot 27 \pm 0 \cdot 01$° C. (Int.), $p_c = 48 \cdot 20 \pm 0 \cdot 02$ normal atm., $v_c = 0 \cdot 148$ l./mol. (4·93 cm^3./gm.), $d_c = 6 \cdot 76$ mol./l. (0·203 gm./cm^3.). The uncertainty in the critical volume and density is 1%. [See following Abstract.] AUTHORS.

2578. Compressibility of Gaseous Ethane in the High Density Region. J. A. Beattie, Gouq-Jen Su and G. L. Simard. *Am. Chem. Soc., J.* 61. *pp.* 926–927, *April*, 1939.—The compressibility of gaseous ethane (C_2H_6) has been studied from 50° to 275° and from 5 to 10 mol./l., thus extending to high densities the data previously obtained [see preceding Abstract]. AUTHORS.

2579. Solid State of H_2, HD and D_2. M. E. Hobbs. *J. Chem. Phys.* 7. *pp.* 318–322, *May*, 1939.—By using the van der Waals field as calculated for H_2 from the second virial coefficient by Lennard-Jones, and the kinetic zero point energy expression given by London in the theory of liquid He, the lattice energies of solid H_2, HD and D_2 have been calculated. The values calculated for the energy at 0° K. are for H_2 $-180\cdot 4$ and for D_2 $-280\cdot 6$ cal./mol. These are in good agreement with the experimental values of $-183\cdot 4$ and $-274\cdot 0$ cal./mol., respectively. The corresponding theoretical values of the volume are $23\cdot 24$ cm^3. ($22\cdot 65$ obs.) for H_2, and $19\cdot 78$ cm^3. ($19\cdot 56$ obs.) for D_2. The values of HD have been predicted. AUTHOR.

2580. Quantum-Mechanical Calculation of the Second Virial-Coefficient of Helium at Low Temperatures. J. de Boer and A. Michels. *Physica*, 6. *pp.* 409–420, *May*, 1939. *In English.*—Using the interaction energy between two He atoms, obtained in a previous paper [see Abstract 351 (1939)] by comparison of the quantum-mechanical expressions for the second virial-coefficient B with the experimental data at temperatures above 40° K., the phases are evaluated by numerical integration of the wave-equation of the relative motion of two He atoms. The integration of the wave-equation for $E = 0$ showed that it is highly probable that no discrete level exists. The phases are used to evaluate the expression for B, which has been given by Uhlenbeck and Beth. The values obtained are compared with the experimental values of Keesom and Kraak at 2·59, 3·09, and 4·22° K. The behaviour of B at very low temperatures is discussed especially as regards the influence of the existence of a discrete level. Finally, the cross-section for the scattering of He on He atoms has been calculated by substituting the phases in the formula given by Massey and Mohr. AUTHORS.

2581. Ternary Systems of Liquids with Separation Phenomena. E. Jänecke. *Zeits. f. phys. Chem.* 184. *Abt.A.* 1. *pp.* 59–85, 1939.—The behaviour of ternary systems is considered theoretically, with and without taking account of the vapour phase. The particular system hexane-formamide-nitrobenzene is investigated experimentally, separation into three liquid phases, formation of two liquid phases of identical density, and equilibria with solids being observed. L. A. W.

2582. Heats of Formation and Entropies of Certain Zinc and Cadmium Halides. R. G. Bates. *Am. Chem. Soc., J.* 61. *pp.* 1040–1044, *May*, 1939.—From e.m.f. measurements of suitable reversible cells, the changes in free energy, heat content and entropy attendant upon the formation of anhydrous $CdBr_2$, $ZnCl_2$, $ZnBr_2$ and ZnI_2 from their elements in the standard states have been computed. Satisfactory agreement with the best calorimetric results was obtained. The entropies of the Cd and Zn halides have been evaluated. AUTHOR.

See also Abstracts 2292, 2301, 2341.

VAPORISATION AND CONDENSATION.

2583. Boiling Point Elevation. Part III. NaCl Solutions (continued). R. P. Smith and D. S. Hirtle. *Am. Chem. Soc., J.* 61. *pp.* 1123–1126, *May*, 1939.—The activity coefficients and osmotic coefficients of NaCl have been determined in the temperature range 60 to 100° for concentrations of 1·0 to 4·0 *M* and compared with those determined from e.m.f. measurements at temperatures between 0 and 40°. The agreement of the relative partial molal heat content as determined from these results together with the e.m.f. results is more satisfactory than that obtained from the e.m.f. results alone. This indicates that the activity coefficients determined from the e.m.f. measurements are low at temperatures near 40°, while those determined from the boiling point elevations are too high at temperatures near 60°. [For Parts I and II see Abstract 1732 (1939).] AUTHORS.

2584. Rate of Evaporation of Tantalum. D. B. Langmuir and L. Malter. *Phys. Rev.* 55. *pp.* 748–749, *April* 15, 1939.—The rate of evaporation of Ta was determined by measuring the change of resistance and the change of weight of uniform filaments. Temperatures were held constant throughout each run by adjustments of voltage V and current A so that $VA^{1/3}$ remained approximately unchanged. The rate of evaporation can be expressed by $\log_{10}M = 7 \cdot 86 - 39{,}310/T$, where M is the rate of evaporation in gm./cm^2./sec. and T is the temperature on the Kelvin scale. [See Abstract 2574 (1939).] AUTHORS.

2585. Vapour Pressure of Thorium Acetylacetonate by Radioactivity Measurements. R. C. Young, C. Goodman and J. Kovitz. *Am. Chem. Soc., J.* 61. *pp.* 876–878, *April,* 1939.—By the use of radioactivity measurements, the vapour pressure of thorium acetylacetonate has been obtained at 100° as $3 \cdot 2 \pm 0 \cdot 3 \times 10^{-4}$ mm. The gas-saturation method was employed, N_2 being used, and from the latter the Th compound was extracted and converted into thorium chloride by alcohol acidified with HCl. A basic thorium chloride deposit was made on a Pt foil, and by means of an α-count of this deposit, the molar quantity of sublimed thorium acetylacetonate was obtained. AUTHORS.

2586. Release of Air Dissolved in Water. A. G. Sillitto. *Roy. Techn. Coll. Glasgow, J.* 4. *pp.* 421–426, *Jan.,* 1939.—The solubility of air in water at a total pressure of 76 cm. Hg is discussed and illustrated by graphs. Experiments have shown that the amount released from solution by raising the temperature is surprisingly small ; this is accounted for by the supersaturation of the solution. The supersaturation produced by raising the temperature or by reducing the pressure is shown to persist for many hours. Contamination by the atmosphere of the surface of the flask used is found to facilitate the release of the air. The part played by air bubbles in promoting boiling and " singing " is noted, and the relation of singing to the comparatively rapid evolution of air at temperatures approaching the boiling point is pointed out. AUTHOR.

See also Abstracts 2302, 2387.

ACOUSTICS.

2587. Combination Tones in Sound and Light. W. H. Bragg. *Roy. Inst., Proc.* 30. 3. *pp.* 424–433, 1939. *Nature,* 143. *pp.* 542–545, *April* 1, 1939.—When during the production of sound by two sources the amplitude of one source depends at every instant upon the amplitude of the other, combinational tones appear. These are demonstrated by means of a coil arrangement with microphone and loud-speaker, using two tones of frequency 50 and 250, and giving the tones 200 and 300. Another method uses two tuning forks, a beam of light and a photo-cell, the effect on which is turned into sound. The way in which a detector can generate accessory tones is also illustrated. In radio transmission of sound, the combination tones are the real carriers; they can be detected separately and are known as side-bands. The Raman effect is based on the same principle. G. E. A.

2588. Propagation of Explosion Waves at the Surface of Separation of Two Media. G. Joos and J. Teltow. *Phys. Zeits.* 40. *pp.* 289–293, *April* 15, 1939.—A description has recently been given by O. v. Schmidt [see Abstract 1306 (1939)] of a type of propagation of explosion waves which has long been known in seismics. A wave propagated in a direction in the less dense medium parallel to the surface of separation from a denser medium gives rise to a new wave-front entering the denser medium at the angle corresponding to total internal reflection. An explanation of this new wave-front was given by v. Schmidt and based on Huygens' principle. Objections are raised to this explanation and it is now shown that an explanation free from such objections is obtained from Somerfeld's stationary solution of the fundamental problem of radio-telegraphy. The question of the applicability or non-applicability of Fresnel's formula is also discussed. A. W.

2589. Secondary Strike Note of Bells. J. Arts. *Acoustical Soc. of America, J.* 10. *pp.* 327–329, *April*, 1939.—Heavy and middle-weight bells, weighing from about 800 k.gm. upwards, emit, in addition to the well recognised strike note, another tone which can be recognised by its intensely clear, metallic character and timbre. The maximum duration observed was 8 sec. The loudness may be equal to or greater than that of the primary strike note. The pitch is that of a fourth above the fifth partial or an eleventh above the primary strike note. Details are given of actual bells in Holland and of the position of the nodal circles involved in the modes of vibration giving rise to this secondary strike note.

W. H. G.

2590. Supersonic Velocity in Air, Steam, CO_2 and CS_2. S. K. K. Jatkar. *Indian Inst. of Science, J.* 22*A*. 6. *pp.* 93–110, 1939.—The results of the present investigation are summarised in the following table :—

	V m./sec.	γ	C_p obs.	C_p cal.
Steam (134°)	496·3	1·3295	8·26	8·26
CO_2 (25°)	269·6	1·3028	8·74	8·68
,, (97·1°)	299·7	1·2899	8·94	8·93
CS_2 (97·1°)	220·1	1·2350	11·2	11·6

[See Abstract 1699 (1939).] AUTHOR.

2591. Supersonic Measurement of Adiabatic Elastic Constants of Crystals. E. Baumgardt. *Comptes Rendus*, 208. *pp.* 1280–1282, *April* 24, 1939.—Since a linear relation exists between the three elastic coefficients in different directions in a crystal it is only necessary to make two measurements instead of the three mentioned in a previous paper [see Abstract 4180 (1938)]. Utilising the phenomena of the diffraction of light by supersonic waves, measurements were made of the velocity of sound in a number of plates of rock-salt and from these results the elastic constants were calculated. The results for plates of natural and artificial crystals were respectively $10^{13} \cdot C_{11} = 4 \cdot 99$ and $5 \cdot 00$, which are in excellent agreement with the value 4·988 obtained by Rose. A possible explanation is given for the lower value of 4·77 obtained by Voigt. A. W.

2592. Dispersion of Supersonic Waves in Liquids. F. Matossi. *Phys. Zeits.* 40. *pp.* 294–297, *April* 15, 1939.—Measurements similar to those of Dutta [see Abstract 2101 (1938)] and at the same temperature, 27° C., showed that evidence of dispersion in the case of water could be obtained without difficulty, but as the temperature was reduced to room temperature the velocity increase in water and toluol with increased frequency could no longer be observed. Under certain conditions, however, dispersion effects could be reproduced even at room-temperature when close coupling to the quartz transmitter was employed, resulting in high values of the sound intensity. The greater the intensity the greater was the dispersion effect observed. With loose coupling to the transmitter the effect could not be observed. It thus appears probable that the observed dispersion is connected with some type of secondary effect associated with high values of sound intensity. A. W.

2593. Sound Localisation. H. Wallach. *Acoustical Soc. of America, J.* 10. *pp.* 270–274, *April*, 1939.—The two factors governing sound localisation which have frequently been discussed in recent years are time difference and intensity difference. Both are supposed to have the same effect: they determine the lateral angle of a given sound to one side or the other. Complete localisation must, however, involve other factors which take account of elevation. Discussion of this shows that the two groups of factors, the known ones which determine the lateral angle and the new ones concerned with elevation, work intimately together and are perhaps even of the same nature. One obtains the cues for a number of lateral angles for the same sound direction by turning one's head while the sound is being made. Experiments with synthetically produced sound directions, controlled by the head movement itself, confirmed this and indicate that the perception of sound direction actually works on this principle. A. W.

2594. Absorption of Sound by Vibrating Plates Backed with an Air Space. R. Rogers. *Acoustical Soc. of America, J.* 10. *pp.* 280–287, *April*, 1939.—In the first part, the theory of one-dimensional reverberation is developed from the case of a long tube, of small cross section compared with the wave-length of any sound it may contain, its ends being closed by plates which move as a whole under the sound pressure. Each plate is backed by an air space of the same cross section as the tube and of a given depth. An equation is found which gives the damping factor as a function of the frequency and other constants of the system. Possible approximations and their ranges of validity are shown to lead to the same result as previous theories that were correct to a first order approximation. The solutions of an equation are given in graph form from which can be found the frequencies of maximum absorption. In the second part the theory is extended to three-dimensional reverberation to obtain absorption coefficients of the type used in the three principal theories of reverberation. The writer is convinced that the quantity of fundamental importance in reverberation theory is the normal acoustic impedance rather than an average absorption coefficient. G. E. A.

2595. Sound Absorptivities by Impedance Method. H. A. Leedy. *Acoustical Soc. of America, J.* 10. *pp.* 288–292, *April*, 1939.—

Using the impedance method, the normal absorptivities are determined theoretically, and some experimental verifications are included. A discussion of the method is first given, which consists in finding the acoustical impedance of a vibrating plate backed by an air space, and hence the damping factor. The normal absorptivity is thereupon derived from an equation given by P. M. Morse. With the aid of certain assumptions, the equations are simplified and applied to determine the absorptivities of three vibrating plates with air spaces behind, for the frequency region in which the assumptions are valid. The results indicate that vibrating plates with considerable absorption at low frequencies can be constructed by using plates which have a large mechanical resistance. The positions of the maximum absorptivities may be predetermined from the specific mass of the plate, the stiffness constant and the depth of the air space.

G. E. A.

2596. Comparison of Sound Absorption Coefficients Obtained by Different Methods. F. J. Willig. *Acoustical Soc. of America, J.* 10. *pp.* 293–299, *April,* 1939.—Three radically different methods of measurement were used. In the first the intensity of the sound incident on and reflected from a sample material was measured out of doors by means of a directional microphone. In the second method sound pressures were measured at loops and nodes of standing waves in a tube with the sample at the end of it and in the third method the time of decay of sound in a reverberation room was obtained with a high speed level recording device. The first method measures the coefficient for any desired angle of incidence, the second uses only normal incidence and the third gives an "average" value of the coefficient. The coefficient of absorption is found to vary with the frequency of the sound and the angle of incidence. Since for most porous materials the variation of absorption with frequency is fairly uniform, the absorption-frequency curve can be determined by taking measurements at a comparatively few frequencies and drawing a smooth curve through the points so located. It is found possible either by the outdoor or by the tube method to obtain a coefficient or set of coefficients which may be used in determining a unique average value for the material, which is essentially the same for either method. Since these methods yield average coefficients between the values obtained from the two most accepted reverberation theories, it would seem that these average coefficients would be at least as useful as those obtained by reverberation methods and at the same time be much more convenient to measure and reproduce. It is suggested that the tube method has so many advantages that it should be accepted as a standard method of measuring absorption coefficients, provided that the average coefficient, and not the normal incidence coefficient, be calculated. A. W.

See also Abstracts 2345, 2519.

V.
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ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2597. Propagation of Electric Currents in Terminated Lines. Solutions of the Telegraphic Equation. R. H. Kent. *Phys. Rev.* 55. *pp.* 762–768, *April* 15, 1939.—By a transformation of Heaviside's general solution, a special solution for the current having the value $\epsilon^{-t}f(t)$ at $x = 0$ is obtained. From this solution, an expression is obtained for the potential difference across the line at $x = 0$ in terms of $f(t)$ and its successive integrals. From this and the terminal conditions a differential equation of negatively infinite order for $f(t)$ is obtained. This equation can be solved to any given degree of approximation by a method of integral operators. An illustrative problem is solved. An integral solution of the telegraphic equation and a corresponding expression for the potential difference at $x = 0$ are given. An alternative method to Heaviside's and Carson's is suggested for obtaining the general solution for the terminated line. [See Abstract 2549 (1936).] AUTHOR.

See also Abstract 2635.

CONDUCTION AND DISCHARGE IN GASES.

2598. Coefficient of Absorption of Small Ions by Neutral Particles in Suspension in Air. Ouang Te-Tchao and H. Le Boiteux. *Comptes Rendus*, 208. *pp.* 1288–1289, *April* 24, 1939.—To determine the coefficient of absorption (α) of small ions by neutral particles in suspension in air, use is made of the relation between the number of large ions (P) and the number of neutral particles (N_0). When equilibrium is established between large and small ions it has previously been shown [see Abstract 1757 (1939)] that $P/N_0 = \alpha/\beta$, where β is the coefficient of recombination between large and small ions. P/N_0 has been measured experimentally and from a relation given by Langevin β is then obtained and hence α. The value of α thus found is $1{\cdot}62 \times 10^{-7}$. From this it is calculated that the number of small ions of each sign produced in the atmosphere per cm^3. per sec. is approximately 10, a value in close agreement with that found in the study of atmospheric ionisation by the radioactive elements. Mme. P. Curie found the number of small ions produced per cm^3. per sec. under the action of radioactive and cosmic radiation to be from 8 to 11 pairs. A. W.

2599. Gaseous Ion Mobility. E. Montel. *Comptes Rendus*, 208. *pp.* 1141–1144, *April* 12, 1939.—Researches have not so far determined whether ions of a certain sign and in specified conditions of temperature and pressure have a definite mobility or whether the figures obtained are average values. Recent developments in the measurement of minute currents have led to a new method of determination by finding the displacement current between two electrodes in a very short space of time. Formulæ are established indicating how this measurement can be used to determine mobilities. E. O. T.

2600. Transition from Glow Discharge to Arc. Hsu Yun Fan. *Phys. Rev.* 55. *pp.* 769–775, *April* 15, 1939.—A paper describing experiments on glow discharges in air, O_2 and N_2 at 1 atm., and in H_2 at pressures ranging from 1 to 13 atm., using various combinations of electrode materials. Electrode materials were Cu, Pt, Al and Mo. Glow discharges between Cu electrodes may exist in H_2 with currents as large as 14 A and, although not simultaneously, at pressures as high as 13 atm. With the other gases and electrode combinations tested the glow was less stable than in H_2. Continuous stability of the glow over long periods may not be expected even with small currents. Additional evidence was found for the hypothesis of electron emission in arcs under high surface field strengths, and characteristic changes of the electrodes in glow discharges have been observed due to sputtering and chemical reaction. The apparatus used is described and the procedure adopted is stated. S. A. S.

2601. Transition Forms between Arc and Glow Discharge in Spark Sequences. H. Kaiser and A. Wallraff. *Zeits. f. Physik*, 112. 3–4. *pp.* 215–222, 1939.—In a previous paper [see Abstract 2114 (1939)] the authors established that the normal form of the spark discharge produced by a Feussner spark generator between Cu, Fe and Pt electrodes was a l.v. h.f. arc. It has been noticed that under the influence of changes of the electrode surfaces the arc discharge changes into a markedly different type of glow discharge. The transition from one form of discharge to the other is examined by rotating mirror and kathode-ray oscillograph methods. Methods for preventing the occurrence of the abnormal discharge form are indicated. J. E. K.

2602. Current-Potential Characteristics of Different High-Current Carbon Arcs. W. Finkelnburg. *Zeits. f. Physik*, 112. 5–6. *pp.* 305–325, 1939.—The current-potential characteristics of d.c. arcs between homogeneous carbons and also between different cored carbons were determined in the region of very high current densities (anode loading up to 280A/cm^2.) as dependent on the diameter of the carbon electrodes, for different arc lengths and different location of the electrodes (coaxial or inclined arrangements). Over 6000 individual measurements were made. All the arc characteristics obtained show after the known falling portion a potential minimum and then, for very high loading, a rise whose steepness is about four times as great for the Beck type of arc as for the other arcs used. Arcs between homogeneous carbons and also carbons cored with K_2SiO_3, with the higher current densities, occur in two forms, a noiseless and a hissing form, the latter being the more stable for very high current densities with homogeneous carbons, the noiseless being the more stable at lower current densities. The arc potential of the noiseless type is 10 to 15 V higher than the other, while in the case of carbons cored with K_2SiO_3 the reverse is the case. Measurements on Beck arcs show that the occurrence of the Beck effect is connected with an irregular rise of the arc potential, shown by a kink in the characteristic. The current strengths of the Beck effect and of the arc potential minimum vary proportionally with the diameter of the positive carbon. The Beck are characteristic is independent of the nature of the negative carbon and there is also practically no difference between the Beck arc characteristics when the carbon electrodes are coaxial or perpendicular to one another. A. W.

2603. Theory of Kathode Fall. W. Weizel, R. Rompe and M. Schön. *Zeits. f. Physik*, 112. 5–6. *pp.* 339–349, 1939.—The necessity is emphasised of separating the theoretical treatment of the different phases of a glow discharge. In the negative glow space charge and field are very small, the particle densities are high, ion diffusion is important, while the quite different assumptions made by Rogowsky [see Abstract 5192 (1932)] for the discharge as a whole are justified for the kathode fall only. An application of Rogowsky's differential equation for the field to this region only should then lead to a successful theory of the kathode fall. So instead of Rogowsky's boundary conditions at anode and kathode, two conditions at the kathode boundary of the negative glow are used where the field is supposed to vanish and the ion current to equal a constant which remains undetermined but is not arbitrary (its value would follow from a theory of the negative glow). Further, the usually assumed variation of the ionisation coefficient with the field, which is correct only for low fields, when an electron is completely stopped by a collision, is replaced by the opposite assumption of a constant ionisation coefficient which is considered plausible for a highly anomalous kathode fall at least. In these conditions the integration is simple and leads to formulæ expressing thickness and potential distribution of the kathode fall in terms of the current density i and the undetermined incoming ion current i_0. If experimental values of V, i and i_0 are used the formulæ lead to reasonable values for the Townsend coefficient γ. L. E. F.

See also Abstracts 2481, 2484, 2524.

CONDUCTION IN SOLIDS AND LIQUIDS.

***2604. Modern Practice in High Voltage Measurements. M. Dutta.** *Science and Culture*, 4. *pp.* 258–262, *Nov.*, 1938, *and pp.* 554–563, *April*, 1939.—In the first part a historical survey of the development in the production and transmission of electrical energy is made, showing the trend towards the utilisation of higher and higher voltages with the consequent need for h.v. testing facilities. In the second part, equipment for the production of h.v. d.c., power frequency, and impulse voltages, and some h.v. measuring methods, are described. R. D.

***2605. Stabilisation of a Valve Electrometer. J. Gillod.** *Comptes Rendus*, 208. *pp.* 1080–1081, *April* 3, 1939.—The method is analogous to that of Rogozinski [see Abstract 1772 (1939)]. But the compensating circuit is so arranged that it produces no actual current and so remains stable. It is illustrated and described in detail. C. A. S.

2606. Variation of Electrical Resistance of Sn-Zn and Pb-Sb Alloys with Composition at Low Temperatures. E. Kurzyniec. *Acad. Polonaise Sci. et Lettres, Bull.* 8–10*A*. *pp.* 489–518, *Oct.–Dec.*, 1938. *In German.*—The ratio, r, of R_t/R_0 has been determined at the temperatures of liquid H_2 and N_2 for Sn-Zn alloys after annealing at 190° C., and Pb-Sb alloys annealed at 225° C. The curve of r against composition for the Sn-Zn alloys has a maximum corresponding to a composition of between 1 and 2 atomic % of Zn at each temperature. With Pb the value of r shows a sharp increase as the Sb content is raised to about 3 at.%, then increases more slowly to a maximum at about 80 at.% Sb, beyond which the value decreases rapidly. R. W. P.

2607. P-T Phase Diagram of Na-K Alloys and Effect of Pressure on Resistance of Liquid Phase. C. H. Kean. *Phys. Rev.* 55. *pp.* 750–754, *April* 15, 1939.—By determining the pressures at which discontinuities occur in resistance isotherms of mixtures of Na and K in various proportions, it has been possible to map out the phase diagram of the binary system Na-K as a function of pressure, temperature and composition. The pressure range is 10,000 kg./cm². and the temperature range from 0° to 150°. The results are presented in two diagrams. The composition of the eutectic in the subsystem (solid Na-solid Na_2K-liquid) is almost independent of pressure over the range, whereas the composition of the eutectic (solid K-solid Na_2K-liquid) moves from about 67 atomic % K at 1 atm. to 59% at 10,000 kg./cm^2. The rise of melting temperature with pressure is markedly less for the alloys than for the pure metals: the rise of melting temperature for first eutectic mentioned above produced by 10,000 kg./cm^2. is 42°, against 68° for pure Na. The corresponding figures for the second eutectic are 42° against 105° for pure K. In addition to the phase data, some results are given for the relative resistance of the liquid alloys as a function of pressure. AUTHOR.

2608. Supraconductors. P. H. van Laer. *Ned. T. Natuurk*, 6. 7. *pp.* 118–130, *and* 6. 8. *pp.* 137–152, 1939.—If certain metals are cooled to low temperatures, their electrical resistance disappears at a transition temperature characteristic of the metal. If a magnetic field is applied at a still lower temperature the resistance can be made to return when the magnetic field reaches a certain "threefold value." This paper describes a thermodynamic study of this magnetic effect on supraconductors, the transition at a constant temperature and the transition taking place in a constant magnetic field. Various formulæ containing expressions for the heat capacity of the metal in question and dealing with these transitions are deduced. Experiments are described to test the formulæ developed above. An apparatus is described to measure the heat capacity at different temperatures and having the specimen under the influence of constant magnetic fields. Curves, which were obtained by the use of a block of tin, are given. Measurements were also made at constant temperatures. The atomic heats of tin in the supraconducting state and in the normal state are also measured at a given temperature. The effect of varying the magnetic field (299 gauss and 138·6 gauss) was observed on these values. G. G.

2609. Conductivities of Dilute Solutions of Sodium Dodecyl Sulphate in Ethyl Alcohol-Water Mixtures. A. F. H. Ward. *Chem. Soc., J. pp.* 522–530, *April*, 1939.—The conductivity of a salt with a large, highly unsymmetrical ion, *viz.*, sodium dodecyl sulphate, has been measured at low concentrations in ethyl alcohol–water mixtures at 20°. The equivalent conductances at infinite dilution have been derived. Although there is considerable variation in the product $\Lambda_0\eta$ for the salt, Walden's rule is approximately obeyed by the dodecyl sulphate ion. Results are compared with those for other large organic ions. The solvation of the ions has been estimated by various methods. Straight lines for Λ plotted against $\sqrt{c}$ show agreement with the Kohlrausch equation in all solutions at sufficiently low concentrations. The slopes of the lines have been compared with theoretical values according to Onsager's equation. Reasonable agreement is found except for mixtures from 80 to 100% of alcohol, where the sodium dodecyl sulphate is incompletely ionised, and from 10 to 50% of alcohol, where the experimental slopes are abnormally low. In this same range, the solubility of sodium dodecyl sulphate rises to extremely high values. An explanation has been suggested to correlate these abnormalities, based on the dual nature of the dodecyl sulphate ion and its interaction with solvent molecules. AUTHOR.

2610. Conductances of Pure and Mixed Salt Solutions. R. W. Bremner with T. G. Thompson and C. L. Utterback. *Am. Chem. Soc., J.* 61. *pp.* 1219–1223, *May*, 1939.—The specific and equivalent conductances of various solutions of salts occurring in sea water have been measured at 5° intervals from 0 to 25° inclusive. The data for pure NaCl and KCl solutions at 25° have been shown to be in close agreement with the measurements of Shedlovsky. Certain electrical conductance data in the "International Critical Tables" are not in good agreement. Temperature coefficients of equivalent conductance have been calculated for the twenty solutions at each of the six temperatures used. Although the coefficients for $MgSO_4$ solutions are quite different from those of NaCl, the addition of $MgSO_4$ to NaCl solutions in the ratio used has no detectable effect upon the coefficients of NaCl. The addition of KCl to NaCl solutions in the ratio used has no detectable effect upon the temperature coefficients of NaCl. The mixture rule and the equation proposed by van Rysselberghe and Nutting give the same results when applied to part of the data on NaCl + KCl solutions at 25°. These results agree with the measured values within the experimental error. AUTHORS.

2611. Variable Semiconductors. Part II. Conclusions. G. Déchêne. *J. de Physique et le Radium,* 10. *pp.* 195–199, *April,* 1939.—Continuation of previous work [see Abstract 2196 (1939)] for alternating current. Mathematical. W. R. A.

See also Abstracts 2574, 2584, 2664 and
1348B. Logarithmic Differential Voltmeter. M. Nuovo.
1350B. Conductivities of Irons and Steels. R. W. Powell.

DIELECTRICS AND CAPACITANCE.

2612. Dielectric Constants of Electrolytes. M. Wierzbicki. *Acad. Polonaise Sci. et Lettres, Bull.* 8–10*A. pp.* 413–422, *Oct.–Dec.,* 1938. *In German.*—Measurements at 60 m. were made at 0–25° C. of solutions in water of LiCl, RbCl, CsCl and KNO_3 in concentrations of 0·0005, 0·001, 0·002 and 0·003 *N*. It is shown that the measured results do not fit the Debye-Falkenhagen relation, but do fit approximately the relation $\Delta D = \Delta D_1 - K \times C$, where ΔD is the fractional increase in dielectric constant due to the electrolyte, ΔD_1 is the corresponding value deduced from the Debye-Falkenhagen relation, C is the concentration, and K is an empirical constant. W. H. W.

2613. Dipole Moments of *Cis*- and *Trans*-Azobenzenes and Related Compounds. G. S. Hartley and R. J. W. Le Fèvre. *Chem. Soc. J. pp.* 531–535, *April,* 1939.—The measurements recorded in this paper show: (1) that *cis*- and *trans*-azobenzenes have moments of 3·0 D. and zero respectively, and that from either form in benzene solution at ordinary temperatures an equilibrium, containing 22% of the *cis*-modification, is produced by illumination with sunlight; (2) that the known *p*-azotoluene is the *trans*-form, which—similarly to azobenzene—is partly converted into its *cis*-variety in sunlight; and (3) that, under the conditions which suffice to isomerise azobenzene and azotoluene, benzene- and toluene-azo-β-naphthols are unchanged. These conclusions, drawn from dielectric-polarisation data, are in agreement with those previously reported by Hartley, obtained by using other methods. AUTHORS.

2614. Dielectric Properties and Ionisation Constants of Amino Acids. W. Carr and W. J. Shutt. *Faraday Soc., Trans.* 35. *pp.* 579–587, *May,* 1939.—A modified form of apparatus for the determination of dielectric constants by the Fürth "force" method is described. The dielectric constants of solutions of some aliphatic aminocarboxylic acids have been measured over a range of pH extending to either side of the isoelectric points, and values of the ionisation constants have been calculated from the results. Similar measurements have been made for the amino-sulphonic acids, taurine and sulphanilic acid. The zwitterion hypothesis may be applied qualitatively to these compounds but apparently the dielectric constants of solutions of these strongly acidic ampholytes do not readily lend themselves to calculation of ionisation constants. The results indicate that the whole of the ampholyte is converted to the zwitterionic form only over an extremely narrow range of pH. AUTHORS.

2615. Thermal Instability of Dielectrics for Alternating Voltages when the Loss Angle is Dependent upon the Field Strength. A. Gemant and S. Whitehead. *Phil. Mag.* 27. *pp.* 582–595, *May*, 1939. —The theory of the thermal instability of dielectrics is extended for alternating voltages with a conductivity dependent upon the field strength. Calculations are made with the simplifying assumption that the field is determined by the distribution of the dielectric constant alone and that the variation with temperature of the latter can be neglected. The equations of thermal stability and of their limiting cases are developed for three main types of the conductivity-temperature function, and formulæ for the breakdown voltage are thence derived for several types of conductivity-field strength function. These formulæ are illustrated by application to some experimental results, showing the variation of breakdown voltage which may be anticipated from certain materials tested. Certain limitations and extensions required in practice are discussed. AUTHORS.

See also Abstracts 2276, 2389.

ELECTROCHEMISTRY.

2616. Electrolytic Formation of Persulphate. Part V. With A.C. Superimposed on D.C. R. Matsuda and T. Nishimori. *Chem. Soc. Japan, Bull.* 14. *pp.* 72–77, *March*, 1939.—The previous parts [see Abstract 5439 (1937)] of the present investigation dealt with the mechanism of persulphate formation, and various influences of experimental conditions, when sulphate solutions were electrolysed with d.c. It was shown that the current efficiencies of electrolytes of sulphate solutions without diaphragm were not inferior to those when it was present, so that kathodic reduction could be assumed as not taking place to any considerable extent in those cases. It cannot be expected therefore that the current efficiency will be improved by such a means as suppressing the kathodic reduction, but it is shown that the anodic oxidation will be influenced, favourably or unfavourably, when a.c. is superimposed upon d.c. Various treatments of the Pt-anode prior to electrolysis caused more or less change in the current efficiency, and the best result was obtained when the anode had been heated by passing a.c. through it. Full experimental details are included in the paper. H. H. HO.

2617. Transference Numbers of Sodium Acetate in Aqueous Solution. D. J. LeRoy and A. R. Gordon. *J. Chem. Phys.* 7. *pp.* 314–315, *May*, 1939.—The transference numbers for sodium acetate in aqueous solution at 25° C. for the concentration range 0·02 *N*–0·17 *N* have been determined by the same method as was used for potassium acetate [see Abstract 3376 (1938)]. The results are in close but not exact agreement with those previously reported by Longsworth. The Longsworth function $t_+^{0\prime}$ is linear in the concentration only up to 0·1 *N*. AUTHORS.

2618. Mechanism of H_2-Electrode Process on Pt. J. Horiuti and M. Ikusima. *Imp. Acad. Tokyo, Proc.* 15. *pp.* 39–44, *Feb.*, 1939. *In English.*—Using D_2 as indicator element, the process at the H_2-electrode has been shown to be $H^+ + H^+ \rightleftharpoons H + H^+ \rightleftharpoons H - H^+ \rightleftharpoons H - H$. The last step is the rate-determining one. The same mechanism has been suggested for the hydrogen electrode process on Hg, Sn and Pb by Horiuti and Okamoto [see Abstract 1828 (1936)]. S. J. G.

2619. Solution Potential of Al in Presence of Gases. N. Goldowski. *Comptes Rendus*, 208. *pp.* 1086–1088, *April* 3, 1939.—The varying results for solution potentials obtained by different observers working with the same metals in the same electrolytes may be ascribed to the effect of the atmosphere on the metal. The potential between a specially prepared Al electrode and a calomel electrode in a 1% solution of NaCl was determined, the Al having been subjected to the action of air, O_2 (dry and moist), H_2 (dry and moist), CO_2 (dry and moist), SO_2, and NH_3. Two superficial alterations occur in the Al. The first is due to the direct action of the gas on the metal, adsorption, possibly leading to chemical combination, taking place. The second is due to the electrolyte, which acts on the surface layer but not on the metal. A. J. M.

2620. Theory of Differential Potentiometric Titration. L. Giraut-Erler. *Comptes Rendus*, 208. *pp.* 1220–1222, *April* 17, 1939.—The theoretical curves are worked out mathematically and shown to agree satisfactorily with experimental results in the case of the neutralisation of HCl by NaOH of various concentrations. C. A. S.

***2621. Polarograph with Solid Electrodes. R. J. Walen and M. Haïssinsky.** *J. de Physique et le Radium*, 10. *pp.* 202–208, *April*, 1939.—An apparatus is described for registering potential-current curves during electrolysis with solid electrodes. The use of the apparatus is illustrated with reference to, *inter alia*, anodic oxidation of oxalic acid, variation of the potential of deposition with the concentration of $CdSO_4$ and of $Pb(NO_3)_2$, anodic deposition of PbO_2. W. R. A.

2622. Depolarisation Potentials of Phenyl Alkyl Ketones in Acid, Neutral, and Basic Media at the Dropping-Mercury Kathode. W. C. Davies and D. P. Evans. *Chem. Soc., J. pp.* 546–554, *April*, 1939.—The depolarisation potentials of some phenyl alkyl ketones in acid, neutral, and basic media have been measured by the polarographic method of Heyrovsky. The polarograms indicate that the depolarisation potentials are smaller (less negative) in solutions of low pH than in neutral and alkaline solutions. As the length of the *n*-alkyl chain increases, the depolarisation potential of the ketone in a basic medium rises, and secondary alkyl groups have a larger effect in the same direction. In acid solution the depolarisation potentials vary irregularly. A study has been made of the heights of the waves given by acetophenone in LiOH solution and by both hydrion and acetophenone in solutions of constant HCl concentration containing varying amounts of acetophenone. AUTHORS.

***2623. Dropping Mercury Electrode. Parts I and II. J. J. Lingane and I. M. Kolthoff.** *Am. Chem. Soc., J.* 61. *pp.* 825–834, *April, and pp.* 1045–1051, *May*, 1939.—In Part I the significance of the various terms in the Ilkovic equation for the diffusion currents obtained with the dropping Hg electrode is discussed. The term "diffusion current constant" is introduced to characterise the diffusion current obtained with a solution containing one millimole/l. of the reducible substance. The significance and method of computing the diffusion coefficient term in the Ilkovic equation is discussed. A simple apparatus for manually obtaining current–voltage curves with the dropping Hg electrode is described. The diffusion current constants of thallous, Pb, Cd, Zn, iodate, and ferricyanide ions were determined in 0·1 *N* KCl at 25°, and compared with the corresponding values calculated from the Ilkovic equation. In the cases of thallous, lead, and iodate ions the agreement between the observed and calculated diffusion current constants was within the limits of experimental error (about ± 1%). In the cases of Zn and Cd ions the observed diffusion current constants were, respectively, 5 and 8% larger than the calculated values. The observed diffusion current constant of ferricyanide ions was 8% smaller than the calculated value. It is concluded that the Ilkovic equation is essentially correct. In Part II the equations developed by Heyrovsky, for the relation between the limiting current in ion reductions with no foreign electrolyte present and the diffusion current in the presence of an excess of indifferent electrolyte, have been modified by taking into account the change in the effective diffusion coefficient of the reducible ions caused by the addition of foreign electrolyte. The increase, or " exaltation," of the migration current of a reducible ion by the preceding discharge of an uncharged substance (*e.g.*, oxygen) has been investigated. Experimental data are given to show that the accumulation of OH-ions at the electrode surface, as a product of the reduction of oxygen, decreases the effective transference number (and hence the exaltation of the migration current) of the reducible ions. It was found that the migration current of a reducible ion can also be increased by the preceding discharge of another reducible ion. The observed exaltation of the migration current of K-ions by the preceding discharge of thallous ions was in good agreement with the calculated value. AUTHORS.

See also Abstracts 2614, 2657.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2624. Mass of Mesotron and Other Elementary Particles. A. Proca and S. Goudsmit. *Comptes Rendus*, 208. *pp.* 884–887, *March* 20, 1939.—By introducing a six-dimensional metric for elementary particles, two dimensions associated with spin and charge being added to space and time, and postulating invariance in this six-dimensional space, it is possible to deduce an equation relating the rest mass of a particle to its spin and charge, and an " intrinsic mass " which is present only in the heavy particles. The equation contains three numerical constants, and if these are determined from the masses of the proton, neutron, and electron, the mass of the mesotron is found to be about 100 electron masses. R. P.

2625. Interaction between Neutrons and Matter. F. A. Heijn. *Ned. T. Natuurk*, 6. 2–3. *pp.* 25–49, 1939.—Report on the methods used for investigating the effects produced by neutrons in their passage through matter and the chief results with a list of 44 references. R. P.

2626. Electron in Radiation Field. O. Scherzer. *Ann. d. Physik*, 34. 7. *pp.* 585–602, *April*, 1939.—In a theoretical consideration of the reaction between light quanta and electrons, an equation is proposed which allows the electromagnetic part of the rest-energy of the electron to be calculated, as far as pair formation and disintegration processes do not contribute to the energy. The equation proposed leads to a finite charge density in the interior of the electron without perturbation of the fourth-dimensional symmetry. The form of the charge density in the interior of the electron remains, however, still undetermined. The equation is useful in considering the cases of bound and very fast moving electrons. G. O. B.

2627. Fourier Analysis of the Diffraction of Electrons by Free Molecules. M. Rouault. *Comptes Rendus,* 208. *pp.* 1290–1292, *April* 24, 1939.—Debye and Pirenne have shown [see Abstract 15 (1939)] that, starting from the angular repartition of electrons diffracted by a gas composed of identical molecules, a function of the repartition of electric charge in a molecule of the gas can be calculated. This function was calculated from the intensity of electrons diffracted by the gas by means of an integral which is here shown to be divergent. A calculation is now made by assuming that the wave associated with electrons scattered at a certain distance from the diffusing centre can be considered as originating from the interference of elementary waves scattered by each element of volume of the molecule. In this way an integral is arrived at which is absolutely convergent. At present it is difficult to say with what precision it is necessary to know the value of this integral in order to obtain interatomic distances with accuracy. This question is briefly discussed. A. W.

2628. Resonance Scattering of Protons by Li. E. C. Creutz. *Phys. Rev.* 55. *pp.* 819–824, *May* 1, 1939.—The scattering of protons by a thick target of Li has been studied in the energy region 272–586 ekV at an angle of 156°, with a ball counter. The number of counts per microcoulomb at 458 ekV is 2·08 times its value at 408 ekV, and at 487 ekV it has dropped to 1·48 times the value at 408 ekV. The energy at which the maximum slope of the thick target curve occurs is within 5 ekV of the energy for the Li γ-ray resonance maximum. The fact that the scattering from a Be crystal increased smoothly with proton energy throughout the region, showed that the resonance effect is not a peculiarity of the counter. This scattering anomaly indicates: (1) that the γ-radiation obtained when Li^7 is bombarded with 440-ekV protons arises from a virtual level of Be^8; (2) that the Be^8 state is odd; and (3) that there are no odd excited states of the α-particle below approximately 13 eMV. AUTHOR.

2629. Creation of Pairs or Positrons by Fast Electrons. H. R. Crane and J. Halpern. *Phys. Rev.* 55. *pp.* 838–844, *May* 1, 1939.—By means of the cloud chamber a search was made for the creation of pairs or positrons by electrons of energies between one and 12 eMV, in air, mica, Pb and Pt. A total of 2588 traversals of electrons through solid materials, and a total track length of 628 m. in air were examined. The abnormally large cross-section for the process, as reported in numerous papers by other workers, was not confirmed. The data found point toward agreement with the theoretical calculations. A test for an anomaly at the threshold (1 eMV) was not attempted, because of the difficulty of making a decisive experiment in a cloud chamber under conditions in which the pairs formed would have very small energy. A résumé of the literature on the subject of pair and positron formation by electrons, and a rather full discussion of the possibilities for error in the experimental method are given. AUTHORS.

2630. Influence of Atomic Electrons on Radiation and Pair Production. J. A. Wheeler and W. E. Lamb, Jr. *Phys. Rev.* 55. *pp.* 858–862, *May* 1, 1939.—A fast electron passing through matter will radiate at a greater rate than would be expected if the atoms traversed presented to the electron simply a static field of force. This follows because of the additional possibility of collisions in which an atom is excited. In a similar way energetic quanta will produce pairs at a greater rate. Consequently the unit of length characteristic of the multiplicative

production of showers will be decreased by a factor which in the case of air amounts to 17%. The probability of radiation and pair formation are not proportional to the square of the nuclear charge but are supplemented by terms linear in atomic number (mass absorption law).
Authors.

See also Abstract 2659.

ELECTROSTATICS.

2631. Electrostatic Potential of Two Equal Coplanar Non-Intersecting Circular Laminæ. I. Kobayashi. *Tohoku Univ., Sci. Reports*, 27. *pp.* 365–391, *Jan.*, 1939. *In German.*—The potential is expressed as a series of Bessel functions in cylindrical coordinates about the centre of both laminæ. By means of the addition theorems the functions referring to one centre can be expressed in terms of the coordinates belonging to the other and in this way equations for the coefficients can be found in terms of the boundary values. The solutions of these equations can be explicitly obtained, but contain sets of coefficients which must be determined numerically by iteration. Tables of these constants are given, and examples of the complete solution of the problem are given. The approximation is very satisfactory, even if the laminæ are in contact, provided their potentials are equal, and with different potentials if they are not too close. R. P.

2632. New Method of Creating Electrification. (Sir) Ambrose Fleming. *Phys. Soc., Proc.* 51. *pp.* 402–406, *May*, 1939.—When certain powdered insulating materials such as SiO_2 are allowed to fall down a tube and strike a perforated metal plate or gauze of Zn, Cu, Ni or Fe, the metal plate becomes electrified positively and the powder negatively. The powder must have grains of nearly equal size and be perfectly dry. The electrification appears to be due to impact, not friction. M. G. S.

MAGNETISM AND ELECTROMAGNETISM.

2633. Relationships between Curie Points of Metals Gd to Tm. L. Néel. *Zeits. f. Elektrochem.* 45. *pp.* 378–379, *May*, 1939.—From theoretical considerations the author deduces that the Curie point temperature in °Abs. is proportional to $S^2(J + 1)/J$. This is tested by comparison with the experimental values of other workers for the elements from Gd to Tm. Using a proportionality factor calculated from the observed Curie point of Gd, satisfactory agreement is obtained between theoretical and observed values for the other elements. L. A. W.

***2634. Design of Efficient Magnets. E. A. Johnson.** *Terr. Mag.* 44. *pp.* 81–83, *March*, 1939.—The note collects in convenient form the design-data for cylindrical magnets, for the purpose of determining their magnetic moments, given their dimensions. Demagnetisation and energy-density curves are given for infinitely long cylinders of Alnico, cobalt steel and tungsten steel. Lines are also added from which may be found the self-demagnetising force for different ratios of length to diameter. A second group of curves gives the remanence properties as a function of the dimension ratio. The method of using the curves to find the moment of a given magnet is explained, and the comparative merits of the three materials are discussed. The Alnico magnets are preferred for applications in terrestrial magnetism. G. E. A.

2635. Inner, Initial, Magnetic Permeability of Iron and Nickel at Ultra-High Radiofrequencies. J. L. Glathart. *Phys. Rev.* 55. *pp.* 833–838, *May* 1, 1939.—A new method for the measurement of the ultra-high frequency, initial, inner permeability of ferromagnetic materials has been developed which gives much greater accuracy and is much faster than the older methods. The probable error is under 1% at a frequency of 197 Mc./sec., as contrasted with previous methods in which the error is of the order of 10 to 20%. This improvement is due to three factors: (1) the use of a coaxial cable instead of Lecher wires, (2) the use of a fine central wire and (3) correction for the influence of the finite conductivity of the resonance system. The magnetic permeability of high-purity, commercial iron wire was found to be $53\cdot8 \pm 0\cdot3$ at $1\cdot97 \times 10^8 \sim$, and 25° C. It was constant for all values of tension up to the breaking point of the wire at 980 gm. force. It also remained constant for superimposed longitudinal magnetic fields up to 100 oersteds. The permeability of commercially pure Ni was found to be $3\cdot61 \pm 0\cdot08$ at the same frequency and temperature. As the temperature was raised the permeability increased to a value of 12·22 at 320° C., beyond which it dropped rapidly to unity at 370° C. AUTHOR.

2636. Temperature Variation of Magnetic Anisotropy of Graphite. K. S. Krishnan and N. Ganguli. *Zeits. f. Krist.* 100. 6. *pp.* 530–536, 1939. *In English.*—The susceptibility normal ($\chi_\perp$), and the difference between the susceptibilities normal and parallel ($\chi_\perp - \chi_\parallel$) to the basal plane of graphite were measured at various temperatures from 90° to 1273° (Abs.). $\chi_\perp$ diminishes very slightly at low temperatures, but is practically constant at higher. $\chi_\perp - \chi_\parallel$ does so also, at first rapidly and then more gradually, being ($\times 10^6$) at 90·1°, 293·6°, 451°, 825°, 1080°, and 1264° respectively 28·8, 24·2, 17, 11·3, 9·0, and 7·8. [See Abstract 1365 (1936).] C. A. S.

2637. Susceptibility of Mercury and of Dilute Alkali-Metal Amalgams. S. R. Rao and S. Aravamuthachari. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 181–209, *March*, 1939.—The magnetic susceptibilities χ of pure Na, K, Rb and liquid Hg have been determined by Curie's method and found to be $+0\cdot60$, $+0\cdot52$, $+0\cdot16$ and $-33\cdot3$ respectively. The latter value, compared with -78 for Hg vapour and -37 for Hg^{++} ions in solution, suggests that liquid Hg consists of Hg^{++} ions with the valency electrons free. For Na amalgams χ shows a flat minimum of $-29\cdot3$ at 6 atomic % Na, probably indicating the formation of the compound $NaHg_{16}$ (calculated $\chi = -31\cdot7$). K and Rb amalgams show a sharp minimum in diamagnetic χ at low concentrations, explained by postulating that the alkali atoms are dispersed singly throughout the Hg and are thus able to exhibit paramagnetism which reduces the diamagnetic χ. At higher concentrations the alkali atoms combine in pairs, which (*cf.* H_2) are diamagnetic, so that the total diamagnetic χ rises again. Since the resistance of amalgams is *lower* than that of pure Hg, the alkali atoms are not present in solid solution. Li amalgams are anomalous, showing a *maximum* diamagnetic χ at low concentrations. S. J. G.

2638. Diamagnetism of A, Kr and Xe. L. Abonnenc. *Comptes Rendus*, 208. *pp.* 986–988, *March* 27, 1939.—The following values of the atomic susceptibilities ($\times 10^6$) of the rare gases have been obtained: A, $-19\cdot2 \pm 0\cdot25$; Kr, $-29\cdot2 \pm 0\cdot2$; Xe, $-44\cdot1 \pm 0\cdot2$. W. R. A.

See also Abstract

1378B. Measurement of Coercive Force. H. Neumann.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2639. Biological Effect of Micro-Waves. G. Mezzadroli. *Accad. Lincei, Atti*, 28. *pp.* 408–411, *Dec.*, 1938.—65 cm. and 59 cm. waves were employed and a study made of their effect on the power of germination of various plants—corn, kidney beans, broad beans and maize. The micro-waves were found to exercise a positive influence on the power of germination, and especially so on the cereals. Besides tests in the laboratory, tests in a field were also made and increases of the order of 10–20% were found. G. G.

***2640. Densitometer for Radiographic Shadows. R. G. Bloch, M. Markham and D. Hoijer.** *Am. J. of Roentgenology and Radium Therapy*, 41. *pp.* 642–647, *April*, 1939.—In investigations of lung tuberculosis it was desired to make very accurate comparisons of the tuberculous calcifications, in respect to density of the radiographs. Densitometers hitherto described were in respect to intensities of light above the illuminations obtainable in these special examinations. A special densitometer, which is described in mechanical detail, has therefore been developed for this particular purpose. B. J. L.

2641. Influence of U.V. Rays on Body Weight. F. Ellinger. *Radiology*, 32. *pp.* 157–160, *Feb.*, 1939.—A weight decrease in white mice was found after radiation with ultra-violet light under certain conditions of nutrition, and an increase in the activity of thyroid gland was made responsible for these results. This seems to provide an additional basis for the histamine theory of the ray-reaction, and has perhaps some bearing on the treatment of certain kinds of adiposity. AUTHOR.

2642. Biological Measurement of Radiations. C. Packard. *Am. J. of Roentgenology and Radium Therapy*, 41. *pp.* 441–443, *March*, 1939.—Practicable differences of measurement of radiation by purely physical means are discussed, since these do not concur with measurements made by use of biological reactions. Whilst results by the latter method have been stated not to be precise, this is not the case, particularly in respect of the eggs of the fruit fly, *Drosophila*. Biological methods are advocated, data and a graph being advanced in this respect. For γ-rays biological and physical methods of measurement show wide difference, which is attributed to difficulties of the purely physical method, biological methods being considered more accurate and practicable. B. J. L.

***2643. Recent Metalix Tube Developments. A. Bouwers and W. J. Oosterkamp.** *Am. J. of Roentgenology and Radium Therapy*, 41. *pp.* 444–447, *March*, 1939.—Describes with sectional drawings and illustrations: (1) a self protective X-ray diagnostic tube in which glass is replaced by an artificial resin insulator "Philite"; (2) a "Rotalix" tube in which the tube anode is rotated, this principle being also applied to a very small "Centralix" dental apparatus; (3) an X-ray therapy tube of cascade type for operation at 10^6 V, (4) a tube for cavity therapy and (5) a tube, with replaceable anode, for crystal structure analysis. B. J. L.

***2644. X-Ray Production and Measurement in 800- to 2000-kV Range. L. C. van Atta and D. L. Northrup.** *Am. J. of Roentgenology and Radium Therapy*, 41. *pp.* 633–636, *April*, 1939.—An e.h.v. electrostatic generator which has been previously described [see Abstract 5009 (1937)] has been applied to produce X-rays between 800 and 2000 kV, although the investigations are limited, since the generator is designed for deuteron research. Terminal voltage is measured by a special voltmeter. The target of the X-ray tube is described in detail and is a double-walled copper cup with an inner lining of lead to secure both effective water cooling and high efficiency of X-ray production. Various curves are shown in respect to X-ray intensity and absorption, particularly as regards the angular distribution of radiation. At 2000 kV the radiation is three times as intense and four times as penetrating as that from a 1·0 million volt machine and compares with the γ-ray spectrum. [See also Abstract 466 B (1938).] B. J. L.

2645. "Double Beam" X-Ray Therapy. (Simultaneous Irradiation through Two Portals at Opposite Sides.) H. F. Friedman and E. Lorenz. *Am. J. of Roentgenology and Radium Therapy,* 41. *pp.* 637–641, *April,* 1939.—In deep therapy, X-ray dosage is commonly given from various directions to produce an adequate dosage at deep seated tumours. The authors describe and illustrate a method whereby the patient is irradiated simultaneously from two different directions. It is stated this gives an almost homogeneous distribution of radiation intensity in the tumour and reduces the time of irradiation in the patient's favour. Curves are given in respect to depth intensities and it is claimed that the biological effect is greater than in the case of alternate use of single fields of irradiation. B. J. L.

***2646. Radium Beam Therapy Research Procedure. L. G. Grimmett.** *Am. J. of Roentgenology and Radium Therapy,* 41. *pp.* 432–436, *March,* 1939.—Details are given of procedures at the Radium Beam Therapy Research Department in London. To avoid human contact in the transference of large Ra units, this is carried out by means of compressed air from the safe to the place of application, with lamp control to show the exact situation of the radium pack. For this purpose a W alloy has been utilised which has the same protective value as Pb. Measurements have been made in respect to the radiation received by the operating staff, which is well below dangerous values. To determine the general radiation received by a patient's body during irradiation of a localised area, special phantoms of the human body have been built up by celluloid plates with intervening conductive graphite. Measurements have also been carried out by the biological method (*i.e.,* use of chick embryo) as to the effectiveness of hard and soft γ-rays, the latter showing greatest biological effects for equal absorption. B. J. L.

***2647. Medical Physics. Part II. W. Friedrich and H. Schreiber.** *Die Physik,* 7. 2. *pp.* 53–78, 1939.—Summarises the main branches of physics as applied to medicine. The subjects discussed, include: X-rays—apparatus for both diagnosis and therapy; radiography—film material, intensifying and fluorescent screens, kinematography, stereoscopy and planigraphy. Methods of measuring the intensity of radiation are reviewed for both X-rays and radium—the dosage units by the ionisation methods and also former methods of measurement and finally protection. For optical radiations, light sources, filters and absorption dosimetry, and protection are considered. Reference is made to the production, measurement and biological effects of short and ultra-short radio waves. After an allusion to the use of kathode rays, the general biophysics of radiation is discussed. An extensive Bibliography is appended. [For Part I see Abstract 504 (1935).] T. A. C.

2648. Present Status of Mitogenetic Radiation. A. Hollaender. *Radiology,* 32. *pp.* 404–410, *April,* 1939.—Since the original report by

Gurwitsch in 1923 over 700 articles and 12 books have been published on this subject. Mitogenetic rays are reported to be u.v. light of 1900–2600 Å of an intensity of 10 to several 1000 quanta/cm^2./sec. and are said to be emitted by many biological reactions and by chemical reactions. This radiation is supposed to cause increased cell division in certain biological materials, to initiate or to accelerate certain enzymatic reactions, and to cause the emission of so-called secondary radiation in many biological materials which are themselves not able to emit primary radiation. In the main, biological materials have been used as detectors, since the only physical tool having sufficient sensitivity for the detection of these radiations is the photoelectric Geiger-Müller counter [see also Abstracts 1754 and 3215 (1938)] and the sensitivity of the photoelectric surfaces sets an upper limit of 500 quanta/cm^2./sec. for the mitogenetic radiations. In many experiments, the disturbance of short radio waves, change in sensitivity of the detector culture, retarding effect of human radiation, climatic changes, cosmic rays, sunspots, terrestrial magnetism have in turn been given as explanations for negative results. The author concludes that the detection of these rays rests at present on an unsound basis. T. A. C.

2649. Clinical Photography. A. C. Mooney. *Radiography*, 5. *pp*. 67–75, *May*, 1939.—Contains practical directions to radiographers on the photography of patients, diseased conditions, surgical operations, autopsy and biopsy specimens in monochrome or colours for both stills and substandard kinematography. Among the subjects discussed are the most suitable types of camera equipment, lenses, depth of focus, photographic emulsions, photoelectric exposure meters and the lighting arrangements necessary to give a high- or low-key illumination to maintain any chosen modelling ratio. [See also Abstract 2694 (1936).] T. A. C.

See also Abstract 2484 and

1360B. Multi-Phase Vector Diagrams in Electrocardiography. H. E. Hollmann.

OSCILLATIONS AND WAVES.

2650. Double Refraction of Electric Waves in Oak. K. F. Lindman. *Zeits. f. techn. Physik*, 20. 3. *pp*. 72–75, 1939.—Stationary waves are formed by reflection of a parallel beam of electromagnetic waves (of wave-length either 13 or 26 cm.), at a metal plate. The displacement of the nodes and antinodes, which occurs when an oak board, cut along the grain, is placed in front of the reflector, gives a means of determining the refractive index of the wood. When the grain is parallel to the electric vector the refractive index is 1·87, and when perpendicular, the refractive index is 1·58, the same values holding for both wave-lengths. Absorption in the oak is negligible, and the anticipated polarisation is found in the radiation transmitted through the wood. J. P. A.

2651. Diffraction of Radio Waves Round the Earth. G. Millington. *Phil. Mag*. 27. *pp*. 517–542, *May*, 1939.—Wwedensky [see Abstract 935 (1937)], van der Pol and Bremmer [see Abstract 3035 (1938)], and Eckersley and Millington [see Abstract 3061B (1938)], have employed three different methods to solve the problem of diffraction of electromagnetic waves round the earth, and their results are expressed differently. A detailed study is therefore made of the apparent differences between these theories, and it is shown that in all but one instance, differences are due to the approximations adopted, and are not fundamental. In calculating the effect of raising transmitter or receiver above the earth, however, a considerable divergence appears between the results of van der Pol and Bremmer on the one hand, and of Eckersley and Millington on the other. Reasons are given to show that an error has probably entered into the method of van der Pol and Bremmer. Finally, a treatment of the problem by Huygens' method is carried out, and shown to be inadequate. J. P. A.

2652. Effect of Transverse Magnetic Field on Refractive Index and Conductivity of Ionised Air. S. S. Banerjee and B. N. Singh. *Science and Culture*, 4. *pp.* 597–598, *April*, 1939.—Using a method previously described for longitudinal magnetic fields [see Abstract 3875 (1938), experiments are performed with a transverse magnetic field, and the results given in curves which resemble those for a longitudinal field. With the tranverse field, however, the conductivity of ionised air does not always reach a maximum at the gyro-frequency, but is considerably affected by the collisional frequency and electron density of the sample. J. P. A.

2653. Scattered Reflections in the Ionosphere. B. Beckmann, W. Menzel and F. Vilbig. *T.F.T.* 28. *pp.* 130–135, *April*, 1939. —Photographic records of apparent heights of ionospheric layers for Oct. 29 and 30, and Nov. 7 and 8, 1938, show a marked distribution of short period echoes from apparent heights above the layers F and 2F. Study of the records shows that (1) the " spots " begin to appear about the time 17·00 and disappear the following morning about the time 8·00. (2) They appear at first above the second F reflection (2F). (3) The 2F-layer frequently forms a sharp lower boundary to the " spot " region. (4) During the night the scattered reflections appear suddenly between F and 2F, and the sharp reflection disappears shortly afterwards. (5) After the disappearance of the extraordinary component, the spots still remain, at great heights. (6) Meanwhile an E-layer at an indefinite height appears intermittently. These phenomena are explained in detail by the assumption of scattering clouds of ionisation in the E-region, which produce M reflections or other long-path reflections from F. The clouds are considered to be the aftermath of auroral disturbances in the polar regions. J. P. A.

2654. Lunar Tides in the Upper Atmosphere. E. V. Appleton and K. Weekes. *Roy. Soc., Proc.* 171*A*. *pp.* 171–187, *May* 19, 1939.—Using the well-known radio methods of upper-atmospheric exploration, a lunar tide has been detected in the Kennelly-Heaviside layer (Region E) of the ionosphere. The magnitude and phase of the tide may be specified by the statement that the experimentally determined expression for the equivalent height of the lower boundary of the layer is found to contain a term of the form $0 \cdot 93 \sin (2t' + 112^\circ)$ km., where t' is the lunar hour angle. The tide is thus semi-diurnal, of the order of 1 km. and attains its maxima about ¾ hr. before the lunar transits. To the accuracy of the experimental results, it is thus in phase with the lunar barometric pressure oscillations, as determined by Chapman for ground level at Greenwich. Difficulties are encountered in reconciling the new results with what has previously been deduced from other geophysical evidence concerning the magnitude and phase of upper-atmospheric oscillations. AUTHORS.

2655. Further Investigations of Very Long Waves Reflected from the Ionosphere. K. G. Budden, J. A. Ratcliffe and M. V. Wilkes. *Roy. Soc., Proc.* 171*A*. *pp.* 188–214, *May* 19, 1939.—The paper describes an extension of the investigation of Best, Ratcliffe and Wilkes [see Abstract 4906 (1936)] concerning the reflection from the ionosphere of waves of

frequency 16 kc./sec. emitted from the British Post office sender GBR at Rugby. An extension to greater distances of the previous measurements of the "Hollingworth interference pattern" formed at the ground, together with the removal of some instrumental difficulties in connection with the "phase apparatus" mentioned in the previous paper, have led to more precise information about the downcoming wave. The observations were explicable on the assumption that reflection was from a height of 67 km. for all angles of incidence between 30° and 60°, and was accompanied by a phase change of 180°; the reflection coefficient of the wave component with electric field in the vertical plane was 0·12 on a September day; the wave was elliptically polarised so that the "electric vector ellipse" was described in a left-handed sense and had its major axis in the vertical plane and the ratio of the axes was about 1·5. Propagation conditions were found to be similar in northerly and easterly directions. Observations on 135 days spread over the period July, 1935, to July, 1938, showed that the reflection height varied during the day as though the waves were reflected from the lowest portions of a "Chapman region" at a level where the atmospheric "scale height" (H) was about 6 km. (corresponding to a temperature of 180° K. for air of normal composition). There was some evidence that the whole of the reflecting region was about 3 km. lower in winter than in summer. Sudden anomalous decreases of reflection height were sometimes observed and it was found that these showed a close relation to fade-outs on short wave-lengths and to other phenomena usually associated with catastrophic ionospheric disturbances. During and after severe magnetic storms or auroral activity the diurnal variation of reflection height was found to be abnormal, and the abnormality persisted for as long as 10 days. During these abnormalities there was some evidence that the value of H was considerably reduced at the level of the reflection.
AUTHORS.

***2656. H.F. Oscillator and Amplifier. R. H. Varian and S. F. Varian.** *J. of Applied Physics,* 10. *pp.* 321–327, *May,* 1939.—A d.c. stream of kathode rays of constant current and speed is sent through a pair of grids between which is an oscillating electric field, parallel to the stream and of such strength as to change the speeds of the kathode rays by appreciable but not too large fractions of their initial speed. After passing these grids the electrons with increased speeds begin to overtake those with decreased speeds ahead of them. This motion groups the electrons into bunches separated by relatively empty spaces. At any point beyond the grids, therefore, the kathode-ray current can be resolved into the original d.c. plus a non-sinusoidal a.c. A considerable fraction of its power can then be converted into power of h.f. oscillations by running the stream through a second pair of grids between which is an a.c. electric field such as to take energy away from the electrons in the bunches. These two a.c. fields are best obtained by making the grids form parts of the surfaces of resonators of the type described by Hansen [see Abstract 3334 B (1938)].
AUTHORS.

See also Abstract 2588 and

1489B. Effect of Curvature of Rectangular Hollow Conductors on the Phase Value of Ultra-Short Waves. H. Buchholz.

PHOTOELECTRICITY.

2657. Photo-E.M.F. of Pt Electrode. E. Hoja. *Zeits. f. phys. Chem.* 42. *Abt.B.* 6. *pp.* 432–439, 1939.—Continuing previous work [see

Abstract 3877 (1938)] the author finds that the photosensitivity of the system Pt-aqueous ZnO paste is dependent, not only on the liquid phase, but also on the pre-treatment of the Pt electrode. Thus if the Pt is previously heated to red heat for a sufficiently long time the photo-e.m.f. is negative, whereas if the Pt is warmed with bichromate-sulphuric acid the photo-e. m.f. becomes positive. The effects are thought to be connected with oxidation of the Pt surface, but no detailed explanation can be given.
L. A. W.

2658. Surface Effect and "Tiefeneffekt" with Compound Photokathodes. R. Fleischer and H. Pech. *Zeits. f. Physik*, 112. 3–4. *pp.* 242–251, 1939.—Previous investigations on alkali oxide layers containing foreign metal atoms [see Abstract 378 (1938)] are continued. The selective maximum of the photoelectric effect of such mixed kathodes is found to depend on the applied voltage, there being a displacement towards longer wave-lengths for increase of voltage up to 2 V and possibly also a reverse displacement as the voltage is further increased (measurements up to 300 V). The corresponding behaviour of the long-wave limit and of the form of the spectral characteristic curve near this limit is also investigated. It is found that neither is dependent upon the voltage for values higher than 10 V (measurements up to 100 V). The results are discussed in terms of the effect of the applied voltages on electrons liberated below the kathode surface (*Tiefeneffekt*). L. A. W.

2659. Townsend Ionisation Coefficients in Cs-Ag-O Photo-Tubes Filled with Argon. W. S. Huxford. *Phys. Rev.* 55. *pp.* 754–762, *April* 15, 1939.—The attempt is made to account for the amplification of photo-currents at low current densities in argon-filled Cs-Ag-O tubes on the basis of Townsend's theory assuming secondary electron emission by positive ions. Special sealed-off tubes were used having parallel plates at various separations and a constant gas pressure. Values of the Townsend coefficients α and γ were determined at each value of field by simultaneous solution of the Townsend equations for two plate separations. The α/p_0 *vs.* E/p_0 plot has a maximum at $E/p_0 \cong 700$ V/cm·mm. The γ-values for the two types of kathodes used are sensibly constant at low fields. Measured values of the striking potentials of the glow discharge are in quantitative agreement with the positive ion mechanism assumed. The photosensitivity of the compound Cs kathodes was found to increase with increase of bombarding ion current. AUTHOR.

2660. Quantitative Treatment of Photoelectric Primary and Secondary Currents. R. Hilsch and R. W. Pohl. *Zeits. f. Physik*, 112. 3–4. *pp.* 252–255, 1939.—The authors give a correction to the theoretical treatment in a previous publication [see Abstract 1356 (1938)]. The correction is small and does not affect the agreement of the theory with experimental data. L. A. W.

PIEZOELECTRICITY.

2661. Dynamic Measurement of Elastic, Electric and Piezo-electric Constants of Rochelle Salt. W. P. Mason. *Phys. Rev.* 55. *pp.* 775–789, *April* 15, 1939.—The elastic, electric and piezoelectric constants of Rochelle salt have been measured at low field strengths by measuring the resonant frequencies and impedance of vibrating crystals. It is shown experimentally that the resonant and anti-resonant frequencies of the crystal are both considerably below the natural mechanical resonant frequency of the crystal in disagreement with the usual derivation of the frequencies of a piezoelectric crystal. By assuming that the piezoelectric stress is proportional to the charge density on the electrodes rather than the potential gradient as usually assumed, theoretical frequencies are obtained which agree with those found experimentally. This theoretical derivation together with the measured frequencies supply values for the piezoelectric constants. The elastic constants measured dynamically show some differences from those measured statically. A large difference is found for the dynamically measured piezoelectric constants from those statically measured, which may be attributed to the finite relaxation time for the piezoelectric elements. AUTHOR.

THERMIONICS.

2662. Time Changes in Emission from Oxide-Coated Kathodes. J. P. Blewett. *Phys. Rev.* 55. *pp.* 713–717, *April* 15, 1939.—The decay of electron emission which sets in when emission-limited current is drawn from an oxide kathode has been studied as a function of anode voltage, anode current, kathode temperature, and tube temperature. It is concluded that the decay is due to a transport of Ba or O_2 by electrolysis and diffusion. A value is deduced for the heat of the diffusion process. Other time variations in emission have been observed and are discussed. AUTHOR.

THERMOELECTRICITY.

2663. Thermoelectric Homogeneous (No. 1) Benedicks-Effect in Liquid Gas-Free Mercury. C. Benedicks and P. Sederholm. *Arkiv f. Mat. Astron. och Fysik*, 26B. *No.* 13. [11 *pp.*], 1939. *In English.*—An apparatus has been constructed on the strangulation principle, permitting of determining the (No. 1) Benedicks-effect in strictly gas-free Hg. The experimental results show a fairly good reproducibility. The (No. 1) Benedicks-effect, known to possess a negative sign in ordinary Hg, has been found to exist in gas-free Hg, and to possess then a positive sign, as was expected. While gas-containing Hg frequently had given varying negative values, approaching to zero, the gas-free Hg has been found to give greater, constant, positive values. The effect has been found to be proportional to $(\Delta t)^2$—as has been found earlier for Hg when giving a negative effect. This proportionality with $(\Delta t)^2$ is specially borne out in an unexpected way by the fact that the curves as observed frequently show an inflection point corresponding to $\Delta t = 0$. As for possible sources of error, it has been established, by using varying periods of reversion, that the terminals exert no appreciable influence on the results; no pressure effect may possibly occur. The change of sign of the observations for Hg afford a definite proof that the effect is not due to any influence of the substance in the vessel, nor to any supposed quasi-solid surface layer of Hg. Thus, a final proof has been obtained of the existence in a liquid metal of the (No. 1) Benedicks-effect. [See also Abstract 3301 (1937).] AUTHORS.

2664. Electrical Resistance and Thermoelectric Force of the Two Allotropic Forms of Thallium. E. Rosenbohm. *Physica*, 6. *pp.* 337–352, *April*, 1939. *In German.*—The electrical resistance of a Tl wire heated in an atmosphere of H_2 is shown to fall by 4·3% at 232° C., the temperature of the α to β transformation. In the presence of O_2 or N_2 the change is less marked and occurs at somewhat lower temperatures. Measurements are also made of E, the thermo-e.m.f. of Tl, and the dE/dT curve for the differential e.m.f. against Cu is shown to have an ill-defined maximum in the neighbourhood of the transformation point. R. W. P.